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ADDITIVE MANUFACTURING: AN ANALYSIS OF INTELLECTUAL PROPERTY RIGHTS ON NAVY ACQUISITION

December 2015

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The intent of this project was to advance previous research into the benefits and challenges of implementing additive manufacturing (AM) in the Navy. Specifically, this project focused on intellectual property (IP) rights, government rights, and the potential impact current laws and regulations may have on AM implementation into the Navy. Research was conducted in a three phases. First, statutory and regulatory laws relating to IP were reviewed to provide a foundation for research analysis. Next, Department of Defense and Navy regulations and policies and government AM and IP reports were reviewed to understand government data-rights standards. Finally, a multi-case study analysis was conducted to determine private and public sector best practices in the management of IP associated with AM. This report concludes with recommendations for Navy management of IP and data rights related to AM.

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ABSTRACT

The intent of this project was to advance previous research into the benefits and challenges of implementing additive manufacturing (AM) in the Navy. Specifically, this project focused on intellectual property (IP) rights, government rights, and the potential impact current laws and regulations may have on AM implementation into the Navy. Research was conducted in a three phases. First, statutory and regulatory laws relating to IP were reviewed to provide a foundation for research analysis. Next, Department of Defense and Navy regulations and policies and government AM and IP reports were reviewed to understand government data-rights standards. Finally, a multi-case study analysis was conducted to determine private and public sector best practices in the management of IP associated with AM. This report concludes with recommendations for Navy management of IP and data rights related to AM.

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LIST OF ACRONYMS AND ABBREVIATIONS

3D	three-dimensional
ABS	acrylonitrile butadiene styrene
ACAT	acquisition category
AM	additive manufacturing
AMF	Additive Manufacturing Facility
APM	A.P. Møller
ASTM	American Society for Testing and Materials
BCA	business case analysis
BBP	Better buying power
CAD	computer-aided design
CD	compact disc
CNO	Chief of Naval Operations
CS	computer software
DAS	data acquisition strategy
DFARS	Defense Federal Acquisition Regulation Supplement
DM	data management
DMDI	Digital Manufacturing & Design Innovation Institute
DMS	data management strategy
DOD	Department of Defense
DON	Department of the Navy
EEA	Economic Espionage Act
E-MALL	electronic mall

FAR	Federal Acquisition Regulation
FDM	fused deposition modeling
GPR	government purpose license rights
IP	intellectual property
IPR	in-process review
ISS	International Space Station
LM3I	Lightweight & Modern Metals Manufacturing Innovation Institute
LMLA	Liblicense Model License Agreement
LOM	laminated object manufacturing
MAJCOM	major commands
MP3	Motion Picture Experts Group audio-layer 3
MRE	meal-ready-to-eat
N4	designator for Deputy Chief of Naval Operations for Fleet Readiness & Logistics
NAMII	National Additive Manufacturing Innovation Institute
NASA	National Aeronautics and Space Administration
NAVAIR	Naval Air Systems Command
NAVSEA	Naval Sea Systems Command
NISO	National Information Standards Organization
NMCARS	Navy Marine Corps Acquisition Regulation Supplement
OSA	open system architecture
PTP	peer-to-peer
R&D	research and development
RIAA	Recording Industry Association of America

SBA	Small Business Administration
SBIR	small business innovation research
SECDEF	Secretary of Defense
SECNAV	Secretary of the Navy
SERU	Shared Electronic Resource Understanding
SGC	solid ground curing
SL	stereolithography
SMRC	Systems and Materials Research Corporation
STL	standard tessellation language
TD	technical data
USC	United States Code
USD (AT&L)	Under Secretary of Defense for Acquisition, Technology, & Logistics
USPTO	United States Patent and Trademark Office
UTSA	Uniform Trade Secrets Act

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—LCDR Carrie Paben

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—LCDR Wendell K. Stephens, Sr.

I. INTRODUCTION

A. BACKGROUND

Additive manufacturing (AM) is quickly becoming a viable capability across the Department of Navy (DON) to increase material readiness while decreasing costs; however, this new technology presents multiple challenges, notably how to contract for intellectual property (IP) rights. Presently, the impact that additive manufacturing has on intellectual property right law is one of the primary concerns within the private sector where additive manufacturing is already producing multiple and varied items from aviation parts to on site surgical equipment. As the DON seeks to protect government data rights while preserving contractor rights to knowledge and innovation, it must develop and adapt new policy to reflect the unique challenges presented by additive manufacturing.

This project discusses the disruptive impact of AM on copyright, patent, trademark, and trade secret law within the private sector. It also identifies potential impacts on government data right policy and provides key decision points for DON to consider when procuring AM support and services.

B. PURPOSE OF RESEARCH

This research identifies the implications of additive manufacturing on intellectual property and data rights with a focus on current DON and public sector contracting policies and procedures. First, the report addresses intellectual property, AM processes, and government data right statutory laws and regulations. Second, the report reviews Department of Defense (DOD) data right policies and procedures, industry concerns with DOD handling of data rights, impacts of AM on intellectual property within the private sector, intellectual property case law, and current efforts to procure AM within both the public and private sector. The focus of each area is on the disruptive nature of AM and potential impacts to government implementation of AM technology.

C. RESEARCH QUESTIONS

As the DON continues to research implementing AM technology within the Fleet, impacts on contracting policy to support government data rights may be substantial. With this in mind, this report addresses several questions.

1. Primary research questions

- How is additive manufacturing impacting copyright, patent, trademark, and trade secret laws?
- How is the private sector contracting for additive manufacturing services and support?
- How is the government currently procuring additive manufacturing capabilities, research and development, and services?

2. Secondary research question

- How can the DON develop and adapt contract policy to support Additive manufacturing capabilities?

D. BENEFITS OF RESEARCH

Current research on AM application in the DON focuses on the potential cost savings associated with inventory and supply chain management; however, this focus on economic and material benefits overlooks intellectual property concerns in procuring AM to support the Fleet. This study will further current research on AM by identifying the range of intellectual property right concerns associated with this progressive technology. It will also recommend key contractual concerns and decision points to consider when procuring AM support and services for the DON.

E. METHODOLOGY

Research was conducted via a multi-phase process. First, accumulated data from articles, scholarly journals, DOD and DON regulations and instructions, and government research reports of AM and IP were analyzed to gain an understanding of general AM processes and IP categories. Next, a review of both historical case law and current impacts of AM within the private sector provided a foundation on which to base potential government data right concerns for the DON. Finally, a multiple case study was

performed on current AM procurement practices across the private and public sectors to extrapolate concerns applicable to the DON.

F. ORGANIZATION OF REPORT

This report is composed of six chapters. Chapter II introduces the reader to intellectual property types and associated laws guiding protection of IP. This chapter also provides a general overview of AM history and processes. The chapter concludes with a discussion of statutory laws and DOD data right regulations. Chapter III provides an in-depth literature review of current DOD data right policy and procedures, history of intellectual property case law associated with digital data, current three-dimensional (3D) print file sharing practices, and a discussion of research on intellectual property right impacts within the private sector. Chapter IV discusses current procurement efforts within the private and public sector as well as recent case litigation associated with 3D printing. Chapter V provides an analysis of AM procurement based on commodity and sourcing strategy, contract vehicle, and various decision factors including assumptions, benefits and incentives, and challenges. Chapter VI provides research findings and recommendations for follow-on research.

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II. BACKGROUND

A. INTRODUCTION

This chapter examines intellectual property, additive manufacturing, statutory laws, and Department of Defense regulations concerning government data rights. It begins with a detailed discussion on intellectual property categories and the laws and regulations that currently guide its use. The focus is centered on specifics of patent, trademark, trade secret and copyright laws that are impacted by additive manufacturing.

Next, are a brief overview of additive manufacturing and a synopsis of additive manufacturing processes. These processes form the basis for intellectual property infringement concerns that will be discussed in later chapters.

Finally, statutory laws and regulations delineating Department of Defense rights in technical data, computer software, and patents are discussed. These guidelines for DOD acquisition of intellectual property will contribute to the procurement and implementation of AM into the Navy.

B. INTELLECTUAL PROPERTY CATEGORIES AND LAWS

Intellectual property is a subdivision of property that refers to inventions and other innovative concepts or ideas created by a person's thought processes. It is divided into two main subcategories: industrial property and copyrights (World Intellectual Property Organization [WIPO], 2004). Industrial property includes patents, trademarks, and trade secrets. Copyright covers literary works, films, music, artistic works, and architectural design (WIPO, 2004).

As a subdivision of property, intellectual property is governed by property law. Intellectual property law protects an owner's right to exclude others from making use of the property. These laws also provide incentives for inventors and creators to continue advancing scientific and technological innovations, encourage these individuals' commitment of resources for further innovation, and spur the economic growth and creation of new jobs and industries.

1. Patents

According to the Legal Information Institute at Cornell Law School, "a patent grants the patent holder the exclusive right to exclude others from making, using, importing, and selling the patented innovation" for a period up to 20 years" (Legal Information Institute, 2015). This can be a "product or process that provides a new way of doing something or offers a new technical solution to a problem" (35 U.S.C. § 101). While under patent, the owner of the invention has the right to give others permission or license to use the invention on mutually agreed terms. A patent owner may also sell the invention rights to someone else who then becomes the new owner of the patent. Title 35, Section 271, of the United States Code, states that patent infringement occurs when someone without proper "authority makes, uses, offers to sell, or sells any patented invention, within the United States, or imports into the United States any patented invention during the term of the patent" (35 U.S.C. § 271(a)). When a patent expires, protection ends and the invention enters the public domain.

There are three primary types of patents—plant, design, and utility. Plant patents are awarded to anyone "who invents or discovers and asexually reproduces any distinct and new variety of plant, including cultivated sports, mutants, hybrids, and newly found seedlings" such as a new variety of rose (35 U.S.C. § 161). A design patent provides protection for "any new, original, and ornamental design for an article of manufacture" such as a new furniture design (35 U.S.C. § 171). Utility patents are defined as "a new and useful process, machine, composition of matter, or [any] new and useful improvement" such as a new type of engine or engine part (35 U.S.C. § 101).

Article I, Section 8, Clause 8, of the Constitution provides authority to Congress to issue patents—"to promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." Established under the Patent Act of 1952 and codified under United States Code Title 35, the United States Patent and Trademark Office (USPTO) is the agency responsible for awarding patents and managing the trademark registration process (35 U.S.C. §1).

2. Marks

There are four categories of marks—trademarks, service marks, collective marks, and certification marks (USPTO, 2015). Trademarks are "words, phrases, symbols, designs, or combinations of these that identify and distinguish the source of the goods of one party from those of others" (United States Patent and Trademark Office [USPTO], 2015, p. 1). Service marks are similar to trademarks, but "identify and distinguish the source of a service rather than goods" (USPTO, 2015, p. 1). Members of an organization or group use collective marks "to distinguish their products or services from non-group members" such as the Professional Golfers Association use of PGA (USPTO, 2015, p. 1). The final type of mark, a certification mark, is "used to show the product or service meets certain characteristics or function levels" such as those from Underwriters Laboratories (Judge Advocate General's School, 2007).

In the United States, marks do not have to be registered to obtain protectable rights. The first user of a mark can establish his/her individual rights to use the mark through the simple use of the mark in commerce associated with goods or services. However, "registering a trademark with the USPTO provides a host of advantages including legal ownership of the mark; exclusive right to use the mark nationwide and in connection with the good or services listed in the registration, public notice of ownership of the mark; the ability to record the U.S. registration with U.S. Customs and Border Protection to prevent importation of infringing foreign goods; the right to use the federal registration symbol "®"; and the ability to bring an action concerning the mark in federal court" (USPTO, 2015, p. 1). Infringement under U.S. trademark law occurs when another person "uses a device to cause confusion as to the source or sponsorship of the goods or services involved" (USPTO, 2015, p. 1).

The Constitution does not provide express authority to Congress to enact Trademark Laws; however, in 1870, the first federal trademark statute was enacted under the Interstate Commerce Clause. This statute was later superseded by the Lanham Act of 1946 and codified under Title 15 of the United States Code (Judge Advocate General's School (United States Army) & American Bar Association, 2007). The Lanham Act

establishes the rights and protections for owners of registered marks. Various state laws also provide additional protection to mark owners.

3. Trade Secrets

Trade secrets refer to formulas, patterns, compilations, program, device, method, and technique or process information used in business. The owner of such an item must have taken precautions to keep it a secret and it must provide an economic advantage over competitors (18 U.S.C. § 1839). Protection is limited due to the nature of trade secrets—"a holder is only protected from unauthorized disclosure and use referred to as misappropriation" (USPTO, 2015, p. 1). If the "holder fails to maintain secrecy or the information is independently discovered" (USPTO, 2015, p. 1) protection is lost. Protection continues "until discovery or loss of the secret" (USPTO, 2015, p. 1).

Two federal acts guide the protection of trade secrets: the Economic Espionage Act (EEA) of 1996 and 18 U.S.C. § 1905 (Disclosure of confidential information). The EEA criminalizes the theft or misappropriation of trade secrets under two provisions: 1) foreign economic espionage requires the "theft of a trade secret to benefit a foreign government, instrumentality or agent" (18 U.S.C. § 1831) and 2) commercial theft of trade secrets is criminal regardless of who benefits (18 U.S.C. 1832). 18 U.S.C. § 1905 makes it a crime for a federal employee to divulge "confidential or proprietary information gained during the course of agency employment" (18 U.S.C. § 1905).

State laws protecting trade secrets fall under the Uniform Trade Secrets Act (UTSA). This act protects against misappropriation of trade secrets allowing courts to award damages and order payment of a royalty to the owner (USPTO, 2015). In 2015, 49 states and the District of Columbia have enacted the UTSA.

4. Copyrights

Copyright refers to original works that "include, but are not limited to: literary works, musical works, dramatic works; pictorial, graphic, and sculptural works; motion picture and audio visual works; sound recordings, and architectural works" (17 U.S.C. § 102(a)). Law associated with copyrights "protect a work from the time it is created in a

fixed form and it provides the creator of an original work the right to reproduce the work, prepare derivative works, distribute copies of the work, and perform and display the work in public" (17 U.S.C. § 106). A violation of these rights is copyright infringement; however, fair use of copyright material for education (i.e., teaching, scholarship or research), news reporting, criticism, or comment is permitted. Per Title 17, Section 107, of the United States Code, fair use allows someone other than the copyright holder, under certain conditions, to copy and distribute material without first obtaining permission from the owner under certain conditions (Wherry, 2002). Copyrights have the longest terms of all intellectual property and are guaranteed based on several factors. These factors include when the work was created, how many people authored the work, anonymity of the author, and if the work was created under a signed work contract (Judge Advocate General's School (United States Army) & American Bar Association, 2007).

According to U.S.C. Title 17, Section 101, a "work made for hire is a work prepared by an employee within the scope of his or her employment" (17 U.S.C. § 101). A work that is "specially ordered or commissioned for use, [when] the parties expressly agree in a signed, written instrument, [is also considered] a work made for hire" (17 U.S.C. § 101). When a work is made for hire, the initial owner of the copyright is the employer or person for whom the work was prepared unless both parties sign a written agreement to the contrary. The copyright term for a "work made for hire is 95 years from the date of publication or 120 years from the date of creation, whichever expires first" (17 U.S.C. § 302(e)). Per Title 17, Section 302, of the U.S. Code, this term also "applies to anonymous and pseudonymous works" (17 U.S.C. § 302(c)).

For all other works, the copyright term depends on if it was created before "or after January 1, 1978, the date the Copyright Act of 1976 and current law took effect (17 U.S.C. § 301). If copyright protection was secured before January 1, 1978, the term of the copyright lasts the lifetime of the author plus 70 years (17 U.S.C. § 303(a)). All works in this category are also "guaranteed at least 25 years of statutory protection" and retained copyright authority through December 31, 2002 (17 U.S.C. 303(a)). If published before December 31, 2002, an additional term of 45 years extends the copyright to the end of 2047 (17 U.S.C. 303(a)). "Works securing federal statutory protection for the first time

on or after January 1, 1978," are automatically protected by a term lasting 70 years after the author's death (17 U.S.C. § 302(a)). If the work is a joint effort, "the term lasts for 70 years after the last surviving author's death" (17 U.S.C. § 302(b)).

C. ADDITIVE MANUFACTURING: A BRIEF HISTORY

Additive manufacturing refers to a suite of manufacturing processes capable of converting modeled data into physical products via a layer-by-layer production process (Gibson, Rosen, & Stucker, 2010). Its origins date back to early technological developments in photosculpture and topography. In 1860, Frenchman François Willème created a somewhat successful photosculpture process to create three-dimensional (3D) replicas of any object or human subject (Bourell, Beaman., Leu, & Rosen, 2009). This process consisted of placing a subject or object in the center of a room with "24 cameras positioned equally around the circumference of the room" (Bourell et al., 2009). Figure 1 depicts a subject posing for a photograph in Willème's studio. A silhouette of each photograph was then used by an artisan to carve a 1/24th cylindrical portion of the figure (Bourell et al., 2009).

Figure 1. Photosculpture Subject in Willème's Studio

Source: Bourell, D. L., Beaman, J. J. Jr., Leu, M. C., & Rosen, D. W. (2009). A brief history of additive manufacturing and the 2009 roadmap for additive manufacturing: Looking back and looking ahead. Retrieved from www.rapidtech.itu.edu.tr

Thirty years later, in 1890, J.E. Blanther designed a method to create topographical relief maps from layered molds. Rudimentary by today's standards, Blanther's method impressed "topographical contour lines on a series of wax plates and cut the plates along these lines" (Bourell et al., 2009). Next, the plates were stacked and the wax section smoothed, creating a 3D surface that corresponded to the terrain indicated by contour lines (Bourell et al., 2009). Over the next century, many new ideas for AM would be proposed, developed, and commercialized; in particular, the second half of the 20th century saw vast improvements in 3D printing and AM technologies.

In 1951, Munz proposed a photo emulsion system that would produce a 3D object from a scanned cross section of the object in a layer-by-layer process (Bourell et al., 2009). Modern day stereolithography techniques share many features with this process.

Seventeen years after Munz, Swainson introduced a process to directly fabricate a three-dimensional object with photosensitive polymer and two laser beams (Bourell et al., 2009). By 1971, a powder process similar to modern direct deposition AM techniques was proposed (Bourell et al., 2009). The first patent describing a laser sintering process would be filed in 1979. Throughout the early 1980s, multiple papers and patents would describe different methods of additive manufacturing. Still, it was not until Charles Hull developed and patented stereolithography (SL) that AM really began to advance. Stereolithography is a manufacturing process that solidifies thin layers of polymer using a laser (Wohlers & Gornet, 2014). This advancement would become the catalyst for the next 30 years of innovation and advancement in AM.

The late 1980s and early 1990s brought a plethora of new AM technologies. In 1986, Carl Deckard, a University of Texas graduate student created and patented selective laser sintering (Gonzalez, 2013). The technique, also known as powder bed fusion, fuses cross-sections of powder into a solid with a computer-controlled laser. Another new technique, sheet lamination, uses a laser to cut a thin sheet of paper, plastic or metal into a desired shape. Another layer is then bonded on top and cut. Through repetition of these steps, an object is created quickly and at low cost (Gonzalez, 2013). One of the earliest patents for sheet lamination was filed in 1987. Additional patents were filed for material extrusion and binder jetting in 1988 and 1989, respectively. Material extrusion pushes liquid plastic or metal through a nozzle following a digital map. The first patent for material extrusion was awarded to S. Scott Crump, the founder of Stratasys Ltd, in 1989 (Gonzalez, 2013). Binder jetting or 3D printing involves applying a powder layer to the print surface and then “shooting a liquid binder on the areas to be solidified” (Gonzalez, 2013). 3D printers form 3D objects by building a layer on top of another layer until the object is complete (Gonzalez, 2013). Developed by a team led by Emanuel Sachs at the Massachusetts Institute of Technology, the first patent was awarded in 1993 (Gonzalez, 2013).

In 1991, fused deposition modeling (FDM), solid ground curing (SGC), and laminated object manufacturing (LOM) were also commercialized (Bourell et al., 2009). In 1992, selective laser sintering and stereolithography also became available (Bourell et

al., 2009). Throughout the remainder of the 1990s, research focused on prototyping applications as multiple new machines were introduced at increasingly lower prices. In the early 2000s, significant technological advancements led to the adoption of AM into the automotive, aerospace, and medical industries (Cotteleer, Holdowsky, & Mahto, 2014). By 2009, the American Society for Testing and Materials (ASTM) International, a global organization recognized for developing and delivering standards within manufacturing, established Committee F42 on Additive Manufacturing Technologies to standardize AM testing, processes, materials, design, and terminology (Wohlers & Gornet, 2014). Within two years, ASTM Committee F42 would publish standard terminology for the industry and release a survey on AM design rules (Wohlers & Gornet, 2014).

Currently, AM includes 13 sub-technologies synthesized into seven distinct process categories: binder jetting, directed energy deposition, material extrusion, material jetting, powder bed fusion, sheet lamination, and vat polymerization (Cotteleer et al., 2014). These processes each offer multiple advantages as shown in Table 1.

Table 1. Advantages and Disadvantages of AM

Technology	AM process	Typical materials	Advantages	Disadvantages
Stereolithography	Vat polymerization	Liquid photopolymer, composites	Complex geometries; detailed parts; smooth finish	Post-curing required; requires support structures
Digital light processing	Vat polymerization	Liquid photopolymer	Allows concurrent production; complex shapes and sizes; high precision	Limited product thickness; limited range of materials
Multi-jet modeling (MJM)	Material jetting	Photopolymers, wax	Good accuracy and surface finish; may use multiple materials (also with color); hands-free removal of support material	Range of wax-like materials is limited; relatively slow build process
Fused deposition modeling	Material extrusion	Thermoplastics	Strong parts; complex geometries	Poorer surface finish and slower build times than SLA
Electron beam melting	Powder bed fusion	Titanium powder, cobalt chrome	Speed; less distortion of parts; less material wastage	Needs finishing; difficult to clean the machine; caution required when dealing with X-rays
Selective laser sintering	Powder bed fusion	Paper, plastic, metal, glass, ceramic, composites	Requires no support structures; high heat and chemical resistant; high speed	Accuracy limited to powder particle size; rough surface finish
Selective heat sintering	Powder bed fusion	Thermoplastic powder	Lower cost than SLS; complex geometries; no support structures required; quick turnaround	New technology with limited track record
Direct metal laser sintering	Powder bed fusion	Stainless steel, cobalt chrome, nickel alloy	Dense components; intricate geometries	Needs finishing; not suitable for large parts
Powder bed and inkjet head printing	Binder jetting	Ceramic powders, metal laminates, acrylic, sand, composites	Full-color models; inexpensive; fast to build	Limited accuracy; poor surface finish
Plaster-based 3D printing	Binder jetting	Bonded plaster, plaster composites	Lower price; enables color printing; high speed; excess powder can be reused	Limited choice of materials; fragile parts
Laminated object manufacturing	Sheet lamination	Paper, plastic, metal laminates, ceramics, composites	Relatively less expensive; no toxic materials; quick to make big parts	Less accurate; non-homogenous parts
Ultrasonic consolidation	Sheet lamination	Metal and metal alloys	Quick to make big parts; faster build speed of newer ultrasonic consolidation systems; generally non-toxic materials	Parts with relatively less accuracy and inconsistent quality compared to other AM processes; need for post-processing
Laser metal deposition	Directed energy deposition	Metals and metal alloys	Multi-material printing capability; ability to build large parts; production flexibility	Relatively higher cost of systems; support structures are required; need for post-processing activities to obtain smooth finish

Source: Cotteleer, M., Holdowsky, J., & Mahto, M. (2014). The 3D opportunity primer: The basics of additive manufacturing. Retrieved from http://dupress.com/articles/the-3d-opportunityprimer-the-basics-of-additive-manufacturing/

Specifically, AM reduces production lead times by 40–90 percent; enables quicker design and test iterations, creation of complex-design and one-off tools, and faster mass customization (i.e., Invisalign Braces); and creates stronger, lighter tools (Louis, Seymour & Joyce, 2014). The potential of additive manufacturing to increase efficiency while decreasing costs and waste has drawn the attention of multiple government agencies including the President.

In August 2012, the National Additive Manufacturing Innovation Institute (NAMII) was launched as a new public-private institute for innovation in Youngstown, Ohio (Huergo, 2012). It included manufacturing firms, universities, community colleges and nonprofit organizations and was selected through a competitive process led by the DOD. Its purpose was to "assist U.S. manufacturers in becoming more competitive and encourage investment in the United States" (Huergo, 2012). Six months later, President Barack Obama recognized the advancements in additive manufacturing during his State of the Union Address stating, "additive manufacturing has the potential to revolutionize the way we make almost everything" and promised the launch of "three new manufacturing innovation institutes from existing resources" (Office of the Press Secretary, 2013). A year later, the White House announced the establishment of two additional DOD-led manufacturing institutes, the Lightweight and Modern Metals Manufacturing Innovation (LM3I) Institute team, headquartered in the Detroit and Digital Manufacturing and Design Innovation (DMDI) Institute team headquartered in Chicago, Illinois. Supported by $140 million in DOD funding, the institutes "serve as regional hubs, bridging the gap between applied research and product development by bringing together companies, universities and other academic and training institutions, and Federal agencies to co-invest in key technology areas that encourage investment and production in the U.S." (Office of the Press Secretary, 2014).

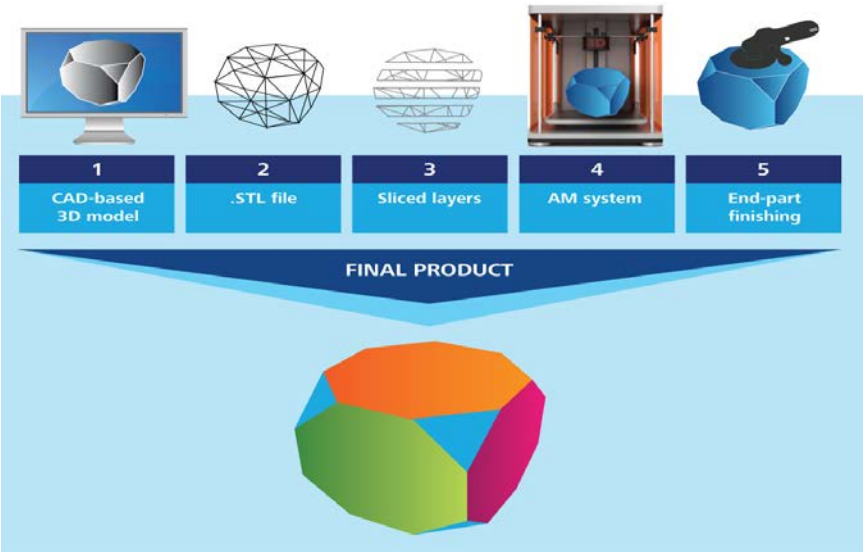
While the DOD invested in these new institutions, the Department of the Navy consolidated over 20 years of AM research and development under a single Navy-wide command. In late 2013, Chief of Naval Operations (CNO) Admiral Greenert appointed Deputy Chief of Naval Operations for Fleet Readiness and Logistics (N4) as the Navy lead for additive manufacturing to oversee the research, development, and standardization of AM within the Fleet (Collum, 2014). A year later, the Navy established its Additive Manufacturing Technology Interchange Charter to continue work implementing AM within the Fleet. This senior group of Navy leaders meets annually to discuss the state of AM within the Navy addressing future capabilities, gaps, and challenges to implementation (Government Accountability Office [GAO], 2015). In 2014, the Navy also installed its first 3D printer onboard USS ESSEX as part of its Print the Fleet

program to develop and print a variety of shipboard items based on Sailor creativity and innovation. By the middle of 2014, the Navy had over 70 AM projects underway at over 20 Navy installations nationwide (Collum, 2014). Navy advances in AM continue to move rapidly. In 2015, the Navy is able to print parts and assemble drones at sea aboard USS ESSEX (Krassenstein, 2015). The Navy is also seeking new ideas for critical metal-cast AM parts such as impellers, engine mounts, and transmission housings (Jordan, 2015). The first critical flight part to be additively manufactured is expected by 2017 (GAO, 2015).

D. ADDITIVE MANUFACTURING PROCESS

Cotteleer, Holdowsky, and Mahto (2013) present a five-step process flow for additive manufacturing methods. First, a virtual 3D model of an object is created utilizing computer-aided design (CAD) software. This model is then saved as a standard tessellation language file (STL). Next, software slices the data file into individual layers to be sent to the AM device. The AM device uses these instructions to create an object by adding material layer-by-layer until the physical object is complete. Once complete, the object is finished using a variety of activities. Secondary processing of sanding, filing, polishing, curing, material fill, or painting may be required depending on the material used and object's complexity. The focus of this research is on the first two steps of this process. Figure 2 depicts the overall AM process flow.

Figure 2. Additive Manufacturing Process Flow



Source: Cotteleer, M., Holdowsky, J., & Mahto, M. (2014). The 3D opportunity primer: The basics of additive manufacturing. Retrieved from http://dupress.com/articles/the-3d-opportunityprimer-the-basics-of-additive-manufacturing/

Conceptualization is the first step to any new design process. This takes many forms from textual, narrative descriptions to drawings, sketches, and representative models. CAD provides a tool to transfer these descriptions, sketches and representations to virtual media usable by AM processing. Reverse engineering equipment such as laser scanning can also be used to create surface representations for already existing objects. CAD software uses this information to create a fully described external geometry for a part which is then transferred to a digital STL file.

STL is the standard file format for nearly every AM technology. STL was derived from stereolithography, the first commercial AM technology developed by Charles Hull, of 3D Systems in the mid-1980s. It removes any construction and modeling history data and replaces it with a series of triangular facets. These triangular facets approximate the model surface describing it in simple geometric terms with an aim of keeping all triangles within the surface of the model. Most CAD programs assist with this step through automatic file conversion and minimum triangle size settings within the software. Despite this automation, there is still room for error during transfer. To correct for errors, repair software may be applied to the STL file as part of an additional check phase. Repair

software should automatically detect and correct errors; however, manual intervention may be required to ensure the part is able to be printed as designed (Gibson, Rosen, & Stucker, 2010).

E. LAWS AND REGULATIONS GUIDING DEPARTMENT OF DEFENSE DATA RIGHT ACQUISITION

Data rights are the government's method of managing license agreements and IP rights related to technical data (TD) and computer software (CS). Technical data refers to any scientific or technical data information that is recorded such as product design, computer databases, and computer software documentation. Computer software refers to any "executable code, source code, code listings, design details, processes, flow charts, and related material" (Defense Acquisition University [DAU], 2015). Government acquisition rarely involves title to or total ownership of TD or CS. Instead, the government generally negotiates for license to use, release, or disclose TD or CS to persons who are not government employees. This is the case even when the government has funded 100 percent of a developmental effort (DAU, 2015). Data rights fall into eight categories:

- Unlimited Rights: Rights under this term provide the government authority to use, or authorize other entities to use, data created at government expense for any purpose the government deems necessary.
- Limited Rights: The party providing the technical data must provide express permission for government to pass the information to a non-governmental third party. These rights permit the government to use proprietary data in whole or in part.
- Government Purpose License Rights (GPR): These rights allow the government "to use, duplicate, or disclose technical data for government purposes" only to include, but limited to, competitive procurement (DAU, 2015). It does not permit the use of data for commercial purposes.
- Restricted Rights: Contractors or subcontractors that independently develop data at private expense may completely restrict government use of the data. Several exceptions apply. Release of technical data is permitted if the technical data "is a correction or change to data furnished by the U.S."; relates to form, fit or function; "is necessary for operation, maintenance, installation or training; [is] publicly available" or has been released or disclosed without restriction (10 U.S.C. 2320).

- Negotiated License Rights: Specially negotiated license rights apply to unique circumstances under which the government and contractor mutually agree to specific license agreements outside of standard licensing.
- Small Business Innovative Research (SBIR) Rights: These rights prevent government users from releasing or disclosing software generated under a SBIR contract to anyone outside of the government except in support of government contractors.
- Commercial Technical Data License Rights: Rights under this group applies to privately, developed commercial item technical data and are managed in the same manner as Limited Rights.
- Commercial Computer Software License Rights: Commercial CS rights are used to manage any commercial computer software or software documentation. The same rights apply as those offered to the public (Department of Defense Open Systems Architecture Data Rights Team, 2013)

In obtaining these rights, the government must also balance contractor economic interests associated with the items, components, and processes developed for the government. Whether developed at private or public expense, technical know-how, trade secrets, and unique designs equate to a competitive advantage in the private sector. Unfortunately, this competitive advantage can quickly turn into a monopoly when contractor ownership of critical technology, manufacturing techniques, or cost-saving procedures eliminate effective competition. Statutory laws and regulations guide the level of data rights for DOD and protect the concerns of private industry. A discussion of these laws and regulations follows.

1. Statutory Laws

A statute is a written law, passed by a state or federal legislature, which sets forth general law propositions to direct or forbid a certain act, make a declaration, or establish government standards to aid society. The United States Code provides three specific statutes to guide government use of intellectual property. These are codified under Title 10, Title 28 and Title 35.

a. Data Rights

Title 10 of the United States Code, Section 2320, Rights in Technical Data, governs and protects the interests of the United States Government, contractors and subcontractors in technical data. Specifically, this statute describes three funding pathways for the development of technical data and associated government data rights. The three pathways are exclusive government funding, exclusive contractor funding, and mixed funding. Prescribed data rights associated with the funding pathways are unlimited rights, limit or restricted rights, and government purpose rights, respectively. The statute also mandates the Secretary of Defense (SECDEF) to provide additional clarification and guidance for DOD data rights under the Federal Acquisition Regulation (FAR). The Defense Federal Acquisition Regulation Supplement (DFARS) provides this guidance under Subpart 227, Sections 70, 71, and 72. These sections will be discussed later in the chapter.

Section 2321 of Title 10 requires contractors and subcontractors to furnish written justification to the contracting officer for technical data use or release restrictions. Additionally, it allows the government three years to review this assertion from the later of either the final payment date to the contractor for the technical data or the actual delivery date of the data. Furthermore, this section allows the DOD to challenge a restriction assertion due to either reasonable grounds to question the restriction or the restriction makes "it impracticable to procure the item competitively at a later time" (10 U.S.C. § 2321(d)(1)). A challenge to the assertion cannot be made after a six year period if the technical data is publicly available, furnished without restrictions, otherwise made available without restrictions, or is the subject of a fraudulently asserted restriction. Notification of the challenge must be sent by the contracting officer in writing with specific details and provide a 60 day justification period. Upon receiving either a justification or no response, the contracting officer will make a decision within 60 days. DFARS Subpart 227, Section 7013, 7014, and 7018 provide additional guidance and will be discussed later in this chapter.

b. Patents

The Bayh-Dole Act of 1980, codified under Title 35, Section 200–212 of the United States Code, established uniform policy for the handling of patentable inventions developed as a part of federally funded research (35 U.S.C. § 200). The act provides the contractor or organization first rights to the title of an invention discovered under federal funding provided the government agency is notified of the invention within 60 days. The contractor must also notify the Government if it plans to retain title to the invention within two years. When a "contractor elects to retain the title, the government [receives] a nonexclusive, nontransferable, irrevocable, paid-up license to [use the invention] on behalf of the government (35 U.S.C. § 202). Additionally, if the contractor retains title, but has not actively pursued a patent, the government may request the contractor provide license to use the invention to another firm to support government requirements (35 U.S.C. § 203). These rights are considered government "march-in" rights.

Title 28, Section 1498 provides recourse for government infringement of patents to the owner. When an owner of a patent does not provide "license or lawful right to use or manufacture" an item for the United States, he/she can seek paid damages for the infringement from the government (28 U.S.C. § 1498). This statute also applies to copyright infringement (28 U.S.C. § 1498).

2. Regulations

From statutes come regulations. Regulations are rules developed to carry out the intent of federal legislation and apply law in a uniform manner. Agencies at every level of government create regulations to guide the activity of those that they govern and provide penalties for violations. The FAR, DFARS, and Navy Marine Corps Acquisition Regulation Supplement (NMCARS) provide guidance for government procurement and use of intellectual property.

a. Federal Acquisition Regulation

The FAR is the primary regulation for the acquisition of supplies and services within the federal government. It provides a simple, uniform, and coordinated approach

to the acquisition process, and eliminates the need for repetition within agency acquisition regulations (Federal Acquisition Regulation [FAR], 2015).

Part 27 of the FAR "prescribes policies, procedures, and contract clauses pertaining to patents, data, and copyrights in federal research, development, and procurement" (FAR, 2015, para 27.000). It also directs agencies to develop specific procedures for managing rights related to data and software. Specifically, this part encourages agencies to use commercial inventions to the maximum extent practicable, mandates contractors indemnify the government against infringement liability, recognizes IP rights to data developed at contractor expense, and requires contractors to obtain permission to use copyrighted works. Five subparts provide additional guidance on infringement: liability, royalties, security considerations and requirements, trade agreements, and government and subcontractor rights. Multiple contract clauses apply to patents, data, and copyrights in government procurement. Appendix A provides a complete list of applicable clauses.

b. Defense Federal Acquisition Regulation Supplement

The Defense Federal Acquisition Regulation Supplement is DOD's guide for the implementation of the FAR. It is issued under the authorization, direction, and control of the SECDEF and provides DOD agencies supplementary guidance to the FAR. This guidance includes law requirements, policies, delegation of authority, "deviations to FAR requirements, and "procedures that have a significant effect beyond DOD internal operating procedures" (Defense Federal Acquisition Regulation Supplement [DFARS], 2015).

DOD procurement guidance for the handling of patents, technical data, computer software, and copyrights is located in DFARS Part 227. Subpart 3 provides multiple clauses associated with patents, data, and copyrights while Subpart 4 mandates DOD agencies to use the DFARS vice the FAR for application of rights in both technical data and computer software. Subpart 7 provides guidance for handling issues related to license and assignment infringement, and specifications for government rights in technical data

and computer software (DFARS, 2015). A list of associated clauses is provided in Appendix B.

c. Navy Marine Corps Acquisition Regulation Supplement

The Navy Marine Corps Acquisition Regulation Supplement provides Department of the Navy uniform policies and procedures to implement and supplement both the FAR and DFARS. It is prepared, issues, and maintained under the authority of the Secretary of the Navy (SECNAV) (Department of the Navy, 2013).

NMCARS Part 5227, Patents, Data and Copyrights, provides guidance on the handling of infringement claims, licenses, and assignments. It mandates license, assignments or other original documents that the originals demonstrating government interest in patents or applications for patents be forwarded to the Chief of Naval Research (Department of the Navy, 2013).

F. SUMMARY

The advance of additive manufacturing technology over the past 20 years combined with intellectual property ownership and government data rights concerns could quickly result in a clash between the government and industry AM stakeholders. This background chapter discussed intellectual property terms, definitions, and federal law to form a foundation for private industry concerns associated with AM. Next, it reviewed the history of additive manufacturing to establish government interest in AM and illustrate the process steps associated with intellectual property ownership and data rights. Finally, a discussion of government data right terminology, statutory laws, and federal and DOD regulations provided a basis for government procurement of data rights.

The next chapter will expand on these intersecting concerns with a discussion of Department of the Navy data rights policy and procedures, analysis of current additive manufacturing concerns and trends in private industry, and review of historical IP case law.

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III. LITERATURE REVIEW

A. INTRODUCTION

This chapter begins with a discussion of DOD policies for obtaining rights to technical data and computer software. It also reviews the procedures set forth to support these DOD policies. Research on DOD procedures for handling and obtaining data rights in acquisition is necessary to understand the potential long-term effects of intellectual property ownership on DOD weapons systems and industry innovation.

Next, this chapter briefly discusses industry concerns associated with DOD handling of data rights. The chapter continues with an overview of industry concerns associated with the increasing accessibility of 3D printing.

Lastly, the chapter discusses case law associated with digital intellectual property rights within the private sector. It is necessary to review case law as digital files like CAD and STL may impact AM implementation into the DON.

B. DEPARTMENT OF DEFENSE DATA RIGHT POLICIES AND PROCEDURES

DOD policy for handling data rights is provided by both the FAR and DFARS. Generally, government agencies are mandated to balance government needs against the contractor's legitimate proprietary interests. Furthermore, government agencies must ensure data rights are only acquired for data essential to their needs. Some guidelines for government acquisition of data rights are to ensure competition on future contracts, provide documentation of completed activities, foster subsequent technological developments, meet statutory requirements, and ensure logistics support (FAR 27, 2015). The DFARS provides similar guidance for CS and computer software documentation (DFARS 227.7203, 2015). The underlying theme of both regulations is government recognition and understanding of contractors' proprietary interests in data, especially those developed at private expense, and the necessity of protecting this information from unauthorized use and disclosure (FAR 27.402, 2015). The following discussion is

provided to illustrate growing DOD focus on balancing government data right requirements against industry concerns for IP.

1. Policies

Government interest in commercial innovations increased in the mid-1990s as a result of a shrinking DOD research and development (R&D) budget. Instead of DOD funding R&D programs, it tapped into industry to benefit from private innovation. At the time, government concern in securing data rights was limited and industry partners retained intellectual property rights. As the DOD budget continues to decrease and the Defense Department is expected to do more with less, data rights policy will also evolve (Erwin, 2014).

In September 2000, Under Secretary of Defense for Acquisition, Technology and Logistics (USD [AT&L]) issued a policy letter acknowledging the shift from government funded research and development to innovations funded by commercial industry. In his letter, Secretary Gansler stated the importance of balancing industry concerns with DOD requirements in order to ensure that defense systems keep pace with industry advances and secure the best commercial products and technologies for the warfighter. To assist the government acquisition workforce with this task, he also ordered the development of an intellectual property handbook (Under Secretary of Defense for Acquisition, Technology and Logistics [USD (AT&L)], 2000).

A year later, a new USD (AT&L) issued another policy letter addressing the reform of contractor IP rights. Specifically, it addressed four key policy areas that should be emphasized within acquisition: specifically negotiated license rights, flexible patent right negotiations, use of performance based acquisition to eliminate data right requirements, and acquiring only essential data rights (USD [AT&L], 2001).

Additional data right policy would not be published again until 2010 when USD (AT&L) released the Better Buying Power (BBP) initiative. BBP 1.0 set forth 23 principle actions to improve government acquisition efficiency. To promote real competition, USD (AT&L) mandated set rules for the acquisition of technical data rights including a business case analysis outlining a program's approach for acquiring data

rights (USD [AT&L], 2010). In 2012, BBP 2.0 continued efforts begun with BBP 1.0 mandating DOD agency consideration of open system architecture (OSA) design methodology. This acquisition method would be further supported by an IP strategy able to be implemented throughout a product's life cycle (USD [AT&L], 2012). Current guidance followed three years later in 2015 with BBP 3.0. Better Buying Power 3.0's purpose is to continue Defense Department efforts to stimulate competition and innovation by ensuring government control of design and data rights through open systems architecture (USD [AT&L], 2015). OSAs provide DOD agencies with established and working frameworks that are able to be studied, reused, modified, enhanced and redistributed by the users of the system (Chief Information Officer, 2009). By utilizing this type of system, DOD reduces its reliance on a single contractor for system service and support allowing for increased competition and more rapid response to changing DOD missions and threats (Department of Defense, 2013).

2. Procedures

To support these policies, both the Defense Department and DON have developed several guidebooks to assist acquisition planners with the procurement of technical data and computer software.

a. Department of Defense Procedures

In 1993, DOD Instruction 5010.12-M, *Procedures for the Acquisition and Management of Data*, was released to DOD components with standardized procedures in the acquisition and management of data in both paper and digital formats (Assistant Secretary of Defense for Production & Logistics [ASD (P&L)], 1993). The manual established standards to:

- Determine data acquisition requirements that meet the minimum of DOD essential needs
- Select tailored data requirements and prioritize commercial data where practicable
- Control data requirement generation
- Increase visibility of data in contracts

- Ensure the price of data acquired is commensurate with benefits of the data (ASD [P&L], 1993).

The manual also mandated acquisition programs develop an adequate data acquisition and management program to assist in identifying all contractual data requirements, provide procedures for changes to data requirements, and establish a process for developing minimum essential data requirements, prices and deliveries. Minimum essential data requirements are based on the intended use of the data as it relates to both near-term and long-term use of the system, material, or service that is related to the data (ASD (P&L), 1993).

Data right management would not be addressed again until 2008 with the release of DOD instruction 5000.02, *Operation of the Defense Acquisition System*. This instruction mandated development of a Data Management Strategy (DMS) for all Acquisition Category (ACAT) I and ACAT II programs to assess data requirements essential to the design, manufacture, and re-competition for production, sustainment, and upgrades of a product. As part of the total system acquisition plan, the DMS addressed contract price options for future delivery of TD and IP not acquired with the initial contract and establishes contractor responsibility for asserting data right restrictions (Department of Defense, 2008).

In late 2013, an interim update to DOD instruction 5000.02 was issued to align acquisition procedures to the policy set forth in BBP 2.0. This edition shifted from a Data Management Strategy requirement to an Intellectual Property Strategy. The IP Strategy requires program managers to manage the full spectrum of IP – from TD & CS deliverables to patent technologies and license rights – for the entire life cycle of a system. New strategy requirements include the complete assessment and competitive procurement of IP, evaluation and updates throughout the life-cycle, incorporation in the acquisition plan, and presentation with the Life-Cycle Sustainment Plan (USD [AT&L], 2013). This interim edition was cancelled and re-issued in January 2015 (USD [AT&L], 2015).

The Defense Acquisition Guidebook provides additional data right guidance for the procurement of TD and CS. The current edition, issued in September 2013, provides

for a Technical Data Rights Strategy. Program Managers are required to conduct and record an analysis of the data necessary to design, manufacture, and sustain a weapons system over the course of its life-cycle. This strategy expands on guidance provided by DOD Instruction 5000.02 by adding a business case analysis (BCA) for future delivery of TD (Department of Defense, 2013). It also includes additional considerations for short-term costs and long-term cost savings related to the ability to compete future production and logistics support while reducing total ownership costs (Department of Defense, 2013).

b. Department of the Navy Procedures

In 2009, Naval Sea Systems Command (NAVSEA) published a Navy specific manual to guide the effective acquisition and management of contractor-prepared data. The *NAVSEA Data Management Program, Operations and Procedures Manual for Contractor Prepared Data* governs all DON components including NAVSEA, Naval Air Systems (NAVAIR), all major commands (MAJCOMS), field activities and all other Navy organizational entities. The manual's objective is to provide an initial resource document to guide data managers and others involved in data management (DM) with recommended approaches to obtaining and managing TD & CS (Naval Seas Systems Command [NAVSEA], 2009).

One approach the manual recommends is the development of a Data Acquisition Strategy (DAS). The DAS integrates planning across multiple principle elements of acquisition including decision milestones, contract definition, procurement objectives, schedule formulation, and program execution. This integration ensures an effective, timely, and economical solution to government data requirements. To support the DAS, the manual also recommends implementing in-process reviews (IPRs). IPRs help establish government ability to use data by providing answers to the following questions:

- What data is needed?
- When is the data needed?
- Who requires and will use the data?
- What data rights will be obtained?

- Why the data is being or will be procured?
- What steps is the program taking to enhance future competition?

Answers to these questions ensure data management does not hinder the effective implementation of a system acquisition plan (NAVSEA, 2009).

C. INDUSTRY CONCERNS WITH DOD DATA RIGHTS

Government management of intellectual property and data rights is regulated by the FAR and DFARS, guided by DOD/DON policy, and drafted per various DOD/DON instructions and manuals. This plethora of guidance creates a complex environment for ensuring the government's best interests for data rights are met. When industry intellectual property concerns are added to this guidance, it becomes even more complex.

In 2001, USD (AT&L), identified 21 industry concerns related to data rights (USD [AT&L], 2001). These have been grouped into seven overarching categories.

1. Application of Intellectual Property Clauses

Industry concerns with the application of IP clauses are three-fold. First, industry dislikes inclusion of patent clauses in contracts because these clauses do not account for industry investment into the creation of IP and can result in an inability of the contractor to secure private funding due to the risk of losing rights to the IP (USD [AT&L], 2001). Second, per mandatory disclosure and filing requirements of patents, industry may have to divulge previously developed trade secrets when partnering with the government (USD [AT&L], 2001). This also neglects consideration for private investment into a new product or process. The possible forced loss of IP rights, a potential source of wealth for private industry, is another concern of industry related to IP clauses in government contracts. Industry views scientists' and engineers' time as a scarce resource, so when faced with a decision between protecting IP and contracting with DOD, industry often chooses to retain its rights (USD [AT&L], 2001).

2. Contractor Retention of Patent Rights

The first issue related to patent rights involves the retention of patent rights when a conceived idea or invention is brought to a workable level for a government contract (USD [AT&L], 2001). The government's right to obtain a government purpose license or exercise "march-in" rights discounts industry investment in developing the idea prior to the government contract (USD [AT&L], 2001). These government "march-in" rights further discourage industry involvement with DOD due to the contractor's potential loss of profit and inability to achieve its return on investment. The contractor also stands to lose this return on investment when it funds subcontractor R&D, but is prevented from claiming ownership of a subcontractor process or product due to FAR and DFARS clauses (USD [AT&L], 2001).

Another issue with patent clauses concerns companies that prefer to keep process inventions as trade secrets (USD [AT&L], 2001). The issue for these companies is that failure to file a patent within the 1-year limit leaves the idea susceptible to the government taking title and patenting the process or product.

Lastly, when industry partners do retain title to an invention, the right to grant exclusive license rights to use or sell products embodying the invention is limited to U.S. manufacturers (FAR Part 52.227-11(g)). This can further affect the contractor's profit margin so many avoid partnering with government (USD [AT&L], 2001).

3. Rights in Noncommercial Technical Data, Computer Software, and Computer Software Documentation

Industry concerns within this category revolve around a mistrust of government entities to use proprietary information correctly. These concerns include too broad of "government" rights definition, the likelihood that proprietary information will end up with a third party or competitor, government removal of proprietary markings and legends, and failure of the government to adhere to license rights, especially when contracting officers turn over (USD [AT&L], 2001). Government acquisition of unnecessary unlimited data rights and contracting officers' refusal to negotiate are additional industry concerns. These actions dissuade industry from partnering with the

government. Another concern is the government's assertion of unlimited rights over everything including copyrighted material when it has fully funded a project (USD [AT&L], 2001). The last concern in this category is that after five years, government purpose rights automatically convert to unlimited data rights. Industry would prefer an opportunity to recoup its investment versus the government automatically gaining unlimited rights (USD [AT&L], 2001).

4. Commercial Item Technical Data

Industry concerns related to technical data for commercial items deal with the poorly defined "emergency" situation in which the government can provide proprietary data to a third party. This concern stems from the potential loss of trade secrets embedded in the technical data (USD [AT&L], 2001).

5. Private Sector License Agreements

License agreements between industry partners are the basis for this concern. Per FAR Part 52.227-6, the contractor may be asked to furnish copies of its license agreements; however, these are often confidential and include information a firm would prefer not to disclose (USD [AT&L], 2001).

6. Disclosure Constraints

This concern is associated with industry's inability to commercialize a new technology without the government's permission. This can be especially problematic on older contracts where the contracting officer has turned over. It can also negatively affect the contractor's profit margin (USD [AT&L], 2001).

7. Deferred Delivery or Ordering of Technical Data & Computer Software

Government interpretation of the data actually generated under a contract is at the center of this industry concern. It stems from industry fear that the government will include proprietary information with basic data rights and the contractor will lose IP rights to the data (USD [AT&L], 2001). The requirement to warehouse contract related data for years after delivery is also burdensome on the contractor. Finally, the

government right to request data for an unknown period in the future also places additional stress on industry partners (USD [AT&L], 2001).

D. INDUSTRY CONCERNS WITH INTELLECTUAL PROPERTY IN ADDITIVE MANUFACTURING

Industry additive manufacturing concerns with IP in the private sector are based on the ease of digital file sharing and increased access to 3D scanning and printing (Reevis & Mendis, 2015). 3D scanners and printers are primarily used to create new and unique items or reproduce products for noncommercial use; however, as 3D technology becomes more affordable, the likelihood of infringement increases (GAO, 2015). CAD files are the mechanism of this infringement and present a particularly complex issue.

CAD files can be produced in a myriad of ways. For example, a CAD file may be created by scanning a drawing of a new product. In this case, the CAD file may be protected under copyright law as an architectural drawing. Conversely, a CAD file created using a computer software program may not be protected because computer software programs are only protected if there is a clear expression of authorship of a digital idea (Osborn, 2014).

CAD files present additional concerns based on the ease of changing a digital file. One primary concern is the ability of a user to remove the trademark section of a file when it is uploaded allowing for reproduction without attribution to the original author. Additionally, due to the ease of manipulating and altering a CAD file, users can change a copyrighted or trademarked file, re-issue it for resale, and claim it as an original work. Lastly, once a file is uploaded, anyone can download the file and print the object for any number of reasons to include commercial use which is also a violation of intellectual property rights (Osborn, 2014).

In a broader context, counterfeiting and mislabeling of replacement parts are a concern in the manufacturing sector (Reevis & Mendis, 2015). Due to the limited availability and capacity of 3D printing, this is not currently high on industry's list of issues; however, with the continued maturation of 3D printing and AM technologies, the issue has been identified as potentially impactful.

E. DIGITAL FILE SHARING IN THE MUSIC INDUSTRY: NAPSTER CASE

Intellectual property right infringement due to digital file sharing networks is not a new issue for lawmakers. Specifically, the music industry has dealt with multiple cases of infringement due to the advancement of Internet technologies over the past 15 years. One of the first and most well-known copyright infringement cases in this context pertained to the music website Napster.

In late 1999, Shawn Fanning created a file sharing program for digital music files known as Napster. This program allowed computer users to share music files via a peer-to-peer (PTP) network at no cost. In order to share files, music enthusiasts created an account with website service to connect with other users and share Motion Picture Experts Group Audio Layer-3 (MP3s) files. MP3s pull digital information from a compact disc (CD), and reduce the file size by approximately one-tenth while retaining nearly the same sound quality (Graves, 2015). MP3s can be created by anyone with the appropriate equipment and a compact disc (CD) of the original artwork/music. Downsizing the total file size permitted a faster, more efficient, and more accessible way to enjoy music from various artists (Lamont, 2013).

Prior to the advent of Napster, standard music formats included vinyl records, cassette tapes, and CDs. Historically, music industry executives used these formats to control consumer access to artists' music by only offering specific singles or entire albums for purchase. This forced music consumers to purchase an entire album even if they only wanted a song or two. Napster disrupted this business practice by providing consumers a resource to selectively obtain individual songs and create customized playlists (Lamont, 2013). By early 2000, Napster had over 20 million users worldwide, and the music industry took notice of this change in music selection.

In late 2000, the Recording Industry Association of America (RIAA), multiple recording executives, recording artist Dr. Dre, and heavy-metal band Metallica filed a joint copyright infringement lawsuit against Napster. The lawsuit cited infringements of copyrights owners' exclusive rights as outlined in Title 17, Section 106 of the United

States Code. Napster countered this action with a claim of fair use according to 17 U.S.C. § 107 (Nieva, 2013).

In order for RIAA and the other plaintiffs' claim to be upheld, they had to show either "ownership of the allegedly infringed material" or "demonstrate that the alleged infringers [violated] at least one exclusive right" afforded them by 17 U.S.C. § 106. In review of the case, the United States Court of Appeals for the Ninth Circuit (Nos. 00–16401, 00–16403) ultimately found "that Napster's users infringed on copyright holders' rights of reproduction and distribution" (*A&M Records et al. v. Napster,* 2000) .

As a result, Napster's claim of fair use per 17 U.S.C. § 107 was not upheld by the court. Per this statute, fair use depends "on the purpose and character of the use [commercial or educational nonprofit], nature of the copyrighted work, amount and substantiality of the portion used, and effect of the use on the potential market or value of the copyrighted work" (17 U.S.C. § 107 (1-4)). The court determined that file downloads:

- Were not transformative
- Could be used for commercial use due to Napster members freely getting a product that would normally be purchased
- Were creative and thus protected by the precedent set forth in statutory law
- Were used for wholesale copying because file sharing transfer involves copying the entire work
- Harmed the present and future download market (*A&M Records et al. v. Napster,* 2000)

In addition to seeking relief from the claims against it, Napster also requested imposition of a monetary penalty in the form of royalties to the artists of the creative works versus an injunction to remove the site. The courts ruled against this request stating that a payment of penalties would allow Napster to avoid penalties for any future violations of injunctions. Enforcing royalty payments would also allow Napster to avoid criminal penalties for infringement, avoid paying for statutory copyright damages, and allow Napster to decide to continue paying royalties or shut down (*A&M Records et al. v. Napster,* 2000). Furthermore, the artists of copyrighted works would also suffer if the

court mandated a royalty payment penalty because artists would lose the power to control their own IP (*A&M Records et al. v. Napster*, 2000).

F. SUMMARY

Historically, the government's policies and procedures for managing IP and data rights have caused industry to exercise caution when partnering with the DOD. As AM technology continues to mature, the appropriate handling of IP contained within CAD and STL files will contribute to the extent that AM is implemented in DON.

This chapter began with a discussion of DOD and DON policies and procedures guiding data rights related to acquisition programs. Next, it reviewed industry concerns with DOD's handling of data rights. It also highlighted private sector concerns particularly associated with CAD files. The chapter concluded with an overview of the disruptive effects digital file sharing created within the music industry to illustrate broader infringement issues with these types of files.

The next chapter will present current government agency and private sector implementation of AM. It will also review legal and mutually beneficial digital file sharing scenarios from academia and private industry.

IV. CASE PRESENTATION

A. INTRODUCTION

This chapter begins with an introduction to case study methodology. Next, it presents two cases illustrating AM implementation in both the private and public sectors. The first private sector case reviews Maersk Group's ongoing implementation of AM within its freighter fleet. The public sector case follows with a review of the multiple ways the National Aeronautics and Space Administration (NASA) has incorporated AM into its research, development, and support of astronauts at the International Space Station (ISS). Two cases illustrating patent infringement among 3D printer companies are also presented. The chapter concludes with a review of examples of current and legitimate digital file sharing. The first case is based within academia and provides a means for reference file sharing. The last two are specific to 3D printing and demonstrate different avenues for appropriate CAD and STL file sharing in private industry.

B. METHODOLOGY

According to Yin (2009), case-study methodology is used in research to gain an understanding of complex phenomena in a real-life context from multiple sources of evidence. This research technique may be used to explain causal links, describe actions to improve the evaluated issue in real-life contexts, illustrate the analysis in a descriptive way, or provide additional knowledge on a topic when it has no clear, related set of outcomes. Case studies can be conducted in a myriad of ways to include single or multiple case based analysis (Yin, 2009). The multiple case study method uses a set of cases with similar attributes to draw a single set of conclusions across the cases. This research will use the multiple case study approach to develop recommendations for DON management of IP and data rights when implementing AM into the Fleet.

C. AM IMPLEMENTATION

This section focuses on the implementation of AM within both the private and public sector. The Maersk Group was selected for analysis based on AM implementation

within its maritime shipping fleet. AM practical applications and handling of CAD and STL files in this particular maritime environment mirror applications DON is interested in implementing within the Fleet.

As a federal agency, NASA was selected for analysis for two reasons. First, the agency is at the forefront of incorporating 3D printing into practical application. Second, as a government agency, NASA must work within the mandates of federal law and the FAR when contracting for the research and development of these AM technologies. These federal guidelines are the same mandates and regulations the DOD must adhere to and will provide a basis for data right handling as DON moves toward broader application of AM across the Navy.

1. Maersk Group

Founded in 1904 by A.P. Møller and his father, Peter Maersk Møller, Maersk has grown from a small steamship transportation company into an international conglomerate focused on shipping, oil, and gas. Now known as The Maersk Group, the company employs over 89,000 people, in 130 countries, across five core business areas. These business areas, Maersk Line, A.P. Møller (APM) Terminals, Maersk Oil, Maersk Drilling, and APM Shipping Services depend on the company's maritime fleet to remain competitive within the global market. Every 15 minutes one of its 500 plus container ships can be found calling on a new port for delivery or receipt of goods; however, due to this worldwide presence and constantly changing locations, it is often difficult for the company to get repair parts to the ships in a timely matter (The Maersk Group, 2015).

In order to deal with the supply chain challenges presented by a vessel at sea, Maersk turned to AM technology as a prospective solution. Specifically, the company is interested in the potential of AM to provide instantly available parts for repairs in the event of unexpected breakdowns or difficulties reaching a ship in time for certain repairs (Laser Systems Europe, 2014).

In July 2014, the company announced an experiment using installed 3D printers onboard some of its tankers. The printer it selected was the Stratasys uPrint SE 3D printer, which used FDM to print Acrylonitrile-Butadiene-Styrene (ABS) thermoplastic

parts. (3ders.org, 2014). ABS is a low-cost engineering plastic that is ideal for structural use due to its excellent impact resistance, strength, and machinability (Plastics International, 2015). To create parts onboard the tankers, Maersk engineers use CAD to create a replica of the repair part needed onboard the ship. This is then translated into a STL file that is electronically sent from Maersk headquarters in Denmark to the ship for printing by onboard personnel. Maersk tested a version of this capability on shore when it 3D printed a part for a protective casing, then forwarded it to a sea borne vessel for installation (Laser Systems Europe, 2014).

2. NASA

President Dwight D. Eisenhower signed the National Aeronautics and Space Act on July 29, 1958 enabling NASA "to provide for research into the problems of flight within and outside of the Earth's atmosphere" (National Aeronautics and Space Act, 1958). Over the past 50 plus years NASA has launched numerous satellites and shuttles into space, landed a man on the moon, and developed, launched, and sustained the ISS (Dick, 2008). In the 21st century, NASA continues to push the boundaries of space exploration by sending humans further into space than ever before. Current efforts involve finding solutions to extend space flights to and human stays on the ISS, an asteroid, and Mars (Wilson, 2015).

Several of these initiatives involve 3D printing to produce on-site and on-demand repair parts and tools. In 2011, NASA awarded a Phase I SBIR contract to Made In Space, Inc. to test the viability of 3D printing in a zero-gravity environment. The 3D Printing in Zero-G Technology Demonstration used a "custom built and commercially available extrusion additive manufacturing" machine (3D printer) to test the effects of microgravity on extrusion-based machines (Snyder, Dunn, and Gonzalez, 2013). After four weeks of testing, Made In Space was able to modify the printers to successfully meet ground specifications in a zero-gravity environment. Due to this success, Made in Space was selected for a follow-on Phase III SBIR contract to further the technology maturation testing on the ISS. In 2014, NASA launched and incorporated its first 3D printer into space (Snyder, Dunn, and Gonzalez, 2013). Following installation, the first 3D part was

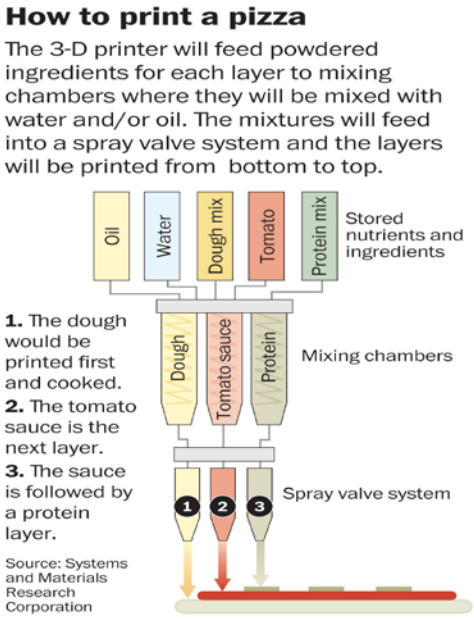
printed in space. The part, a ratchet wrench, was designed by a Made In Space engineer on the ground and transmitted to the printer for production. An additional 19 parts that were pre-loaded on the printer were also successfully produced. All of the parts returned to NASA's Marshall Space Flight Center in early 2015 for additional testing (Rainey, 2015).

The success of the 3D Print in Zero-G initiative spurred additional projects for 3D printing in space. These additional projects include an Additive Manufacturing Facility (AMF) for the ISS to assist with on-demand fabrication in space (NASA, 2015). Made in Space was also awarded this project under a Phase II SBIR contract in 2011 (Small Business Administration [SBA], 2012). The objective for the project is to provide on-demand repair and production capability allowing the ISS crew to perform station maintenance, build tools, and repair sections of the station in case of emergency (SBA, 2012).

In addition to on-demand repair parts and tools, NASA is now researching how to produce food via 3D printing (Jayakumar, 2013). Currently, astronauts consume meals-ready-to-eat (MREs) while onboard the ISS (Systems and Materials Research Corporation, 2014). The MREs are provided via re-supply missions and have a limited shelf-life of five years (NASA, 2015). Additionally, MREs provide limited nutrition to astronauts so a different source of food is required for extended space travel (Systems and Materials Research Corporation, 2014).

To support the nutritional needs required by extended space travel, provide more appealing flavor and textures, and allow for on-demand food selection, NASA awarded a Phase I SBIR contract to Systems and Materials Research Corporation (SMRC) in 2014. SMRC will use AM technology to develop and test a 3D print system capable of producing nutrient rich food able to support extended space travel with long-term shelf life (SBA, 2013). This approach to providing food to current and future astronauts provides the potential to create more nutritious food that can be stored for a longer period of time than current practices allow (Jayakumar, 2013). Figure 3 provides an illustration of SMRC's conceptual end product.

Figure 3. SMRC 3D Food Printer



Source: Jayakumar, A. (2013, May 21). NASA asks: Could 3-D-printed food fuel a mission to Mars? *The Washington Post*. Retrieved from https://www.washingtonpost.com/business/technology/nasa-asks-could-3-d-printed-food-fuel-a-mission-to-mars/2013/05/21/76fc3668-c224-11e2-914f-a7aba60512a7_story.html

D. PATENT INFRINGEMENT: 3D PRINTERS

As DON begins to implement AM within the Fleet, sourcing 3D printers may become a challenge. Per FAR Part 12, all government agencies are required to determine if commercial or non-development products are available to meet government requirements (FAR, 2015, para. 101). In the case of 3D printers patent infringement and trade secrets may create a problem for utilizing commercial 3D printers in the Fleet. The following two cases each illustrate industry patent infringement concerns.

1. Stratasys v. Afinia

Stratasys was founded in 1989 by Scott Crump, inventor of additive manufacturing FDM technology (Pederson, 2005). Initially, the company provided 3D printing of prototypes for major companies (Stratasys Ltd, 2015). Since that time, Stratasys has moved into the commercial market by acquiring several smaller 3D start-ups (Earls, 2011).

Stratasys's first merger was with Objet in 2012 (Stratasys Ltd, 2015). Objet is the first producer of a 3D printer able to simultaneously print more than 100 materials. This merger helped raise Stratasys's status as a leader in 3D printing and AM materials (Stratasys Ltd, 2015). A year later, Stratasys acquired MakerBot in an effort to enter the rapidly growing desktop printer market. (Stratasys Ltd, 2015). These acquisitions kept Stratasys at the top of the 3D printing industry and in 2015, the company is a worldwide leader in 3D printing services and solutions (Stratasys Ltd, 2015). The company's current suite of services includes 3D printer and AM material sales, AM & 3D printing services, and online communities offering access to free design components and 3D digital files (Stratasys Ltd, 2015).

Stratasys's rise has not been without challenges. In November 2013, the company filed a lawsuit against Microboards Technology LLC, the parent company of the Afinia brand H-series 3D printers. In its lawsuit, Stratasys cites four patent infringements against its material extrusion technology by Afinia (Hornick & Rosario, 2015). Afinia contested this claim and after initial review by the USPTO, Stratasys was ordered to drop one of the four patent claims due to its own breech of patent law (Hornick & Rosario, 2015). The other three patent claims were upheld by the District Court of Minnesota in June 2015 during a claim construction hearing (*Stratasys, Inc. v. Microboards Technology LLC*, 2015). As of November 2015, Stratasys and Microboards still have not reached a settlement. If the companies are unable to reach an agreement, the case will go to court in June 2016 (Hornick & Rosario, 2015).

While results of the case cannot be predicted, impacts from this dispute on the 3D printer industry could be significant, no matter the outcome. If Stratasys prevails, Afinia may be mandated to pay damages to Stratasys and/or stop future sales of its product (Hornick & Rosario, 2015). In a broader sense, a win by Stratasys could also mean future injunctions and monetary penalties for other 3D printer companies (Hornick & Rosario, 2015). Additionally, a win for Stratasys could slow the advance of 3D printer hardware as small start-up companies will likely not want to risk infringing on patents of established companies.

Conversely, a decision in Afinia's favor will prevent Stratasys from pursuing similar actions against other companies using similar technology based in expiring patents (Hornick & Rosario, 2015). Stratasys could also license its technology, resulting in royalty payments from companies utilizing the patented technology (Hornick & Rosario, 2015).

2. 3D Systems v. Formlabs

In a similar but unrelated case, 3D Systems, another desktop 3D print technology leader, filed a patent infringement suit against Formlabs in 2012 in association with its laser-based stereolithography technology (Biggs, 2014). In contrast to Stratasys v. Microboards Technology LLC, 3D Systems and Formlabs were able to reach a settlement after two years of litigation (Molitch-Hou, 2014). Specific details of the settlement are unknown; however, a publicly accessible filing with the Securities and Exchange Commission states that Formlabs will pay 8% of its total net sales to 3D Systems in exchange for a world-wide, non-exclusive, royalty bearing license to 8 of 3D Systems's patents (Woodward, 2014).

E. DIGITAL FILE SHARING

The following selections focus on legal and mutually beneficial electronic file sharing to demonstrate possible solutions for CAD and STL file management within the DON. The first case reviews the policy and procedures used in the academic arena to allow students moderated access to scholarly works. The last two cases illustrate private sector 3D file sharing; one provides for copyright and licensing protection and the second illustrates free-source file sharing.

1. Academic License Agreements

The advent of the Internet and increasing accessibility to the worldwide web have changed how academic research is performed as well as the level of demand for access to scholarly work over the past 20 years. Traditional research consisted of long hours spent in a library, combing through physical books, journals, newspapers, and microfiche. The digital age has greatly changed this process by making scholarly works available with

just a few key strokes, shortening the time spent researching, and increasing the volume of research able to be completed in a limited time frame. This has created some unique challenges for university libraries as they seek to provide digital resources to their population, while also protecting the intellectual property rights of authors and publishers.

The National Information Standards Organization (NISO) was founded in 1939 to provide guidance, oversight, and standards for the use of information (National Information Standards Organization [NISO], 2015). To assist universities in meeting this mission in the Internet age, NISO has facilitated digital access agreements between scholarly institutions, publishers, and owners of intellectual property.

The Shared Electronic Resource Understanding (SERU) is one such agreement that NISO has coordinated between institutions of higher education and intellectual property owners. SERU provides an acquisition vehicle for university libraries that want fast, high-standard, low-cost, short-term scholastic publishing agreements. According to NISO's working group headed by Ivy Anderson, SERU does not include copyright language found in more robust agreements such as the Liblicense Model License Agreement (LMLA) (NISO, 2008). Instead, it provides a more informal agreement in which parties cannot violate the intellectual property rights of the publisher. Once the agreement is formed, libraries have limited access to the SERU affiliated content in addition to archival retrieval of data available via the publisher's or a third parties' server. These agreements reduce overall cost by alleviating required licensing documents, licensing terminologies, and the need for legal representation on library staff. Parties using SERU are "agreeing to operate within a framework of shared understanding and good faith" (NISO, 2008, p. 5). This type of agreement has worked for libraries at smaller universities that do not have the budget to accommodate an onsite legal or copyrights department (NISO, 2008).

The LMLA is another standardized digital content licensing agreement that NISO has provided to assist information professionals when negotiating with IP owners for the management and use of scholarly works (Okerson, 1999). It is specifically tailored to universities and its language focuses on subscription based content (NISO, 2015). For

example, a higher learning institute may enter into an agreement with a business journal to allow students unlimited access to the journal's articles for a nominal fee paid by the university. This agreement protects the IP rights of the journal while also allowing students and faculty access to a wide array of scholarly works (Okerson, 1999).

2. CAD and STL File Sharing

Understanding the various means of sharing CAD and STL files within the private sector provides a foundation for identifying DON AM file sharing concerns and recommending solutions. The following cases were selected to illustrate different legal avenues for digital file sharing. Specifically, Shapeways was selected to illustrate a pay-per-purchase 3D file sharing system. The second case reviews Traceparts's system for offering an online market place for major manufacturers to advertise and sell replacement parts via digital files.

a. Shapeways

Peter Weijmarshausen, Marleen Vogelaar, and Robert Schouwenburg founded Shapeways in 2007 to provide 3D designers a way to print a physical end product of their designs (Shapeways, 2015). Eight years later, Shapeways is a world leader in 3D printing services and has expanded into 3D digital file advertising, selling, and sharing. (Shapeways, 2015). Through the Shapeways website, designers are able to upload and print designs for personal use for the price of the material used to print the final product. Designers are also able to post and sell designs on the website for a minimal payment processing fee of 3.5% (Shapeways, 2015). Shoppers use the website by selecting a design and the material to print the selection in, and then they pay.

Designers that choose to upload and sell designs on the website must agree to several terms and conditions related to IP and infringement rights. In posting a design to the Shapeways file sharing site, the designer grants "Shapeways a non-exclusive, royalty free, worldwide, transferable, sublicensable right and license" to manufacture the design per designer request, manufacture the design when purchased, use the design for website advertisement and train its engineers using the design (Shapeways, 2015, para. 6). These rights are granted to Shapeways until the designer chooses to remove the file from the

website (Shapeways, 2015). At that time, all files and forms related to the design are deleted from Shapeways records (Shapeways, 2015). Shoppers must adhere to copyright infringement laws and only download files to be printed at home for non-commercial use (Shapeways, 2015).

b. Traceparts

Traceparts is a French owned online marketplace for 3D spare part files (Traceparts, 2015). The web service offers manufacturers a vehicle to advertise and sell digital files to customers. Customers have free access to a database of hundreds of supplier e-catalogs and millions of 3D models (Traceparts, 2015). When a customer selects a part, he or she can request a quote from the supplier. The customer then selects either a 3D downloadable file or to have the part 3D printed and mailed.

Copyright and legal considerations fall under French laws and include authorization to copy and download files as long as all copyright and legal notices are included in the reproduction (Traceparts, 2015). In addition to Traceparts's IP policies, each manufacturer also provides terms of use. For example, 3M advertises and offers quotes for its parts through Traceparts, but provides further user terms through its website. Specifically, 3M allows its customers to view, download, and reproduce its products for non-commercial use and requires inclusion of 3M's copyright notice (3M. 2015). 3M also provides specific terms for U.S. Government users; any use by the U.S. Government is directed by DFARS 252.227-7013(c)(1)(iii) and FAR 52.227-19 (3M, 2015).

F. SUMMARY

The advance of AM technology in both the public and private sector has had its share of challenges. The cases in this chapter were selected to illustrate some of the difficulties associated with the development and procurement of 3D printing hardware as well as the challenges of managing IP in digital forums. They were also selected to illustrate potential avenues of AM research and development specific to the Navy's needs as well as avenues for mutually beneficial 3D digital file sharing.

Chapter V will use these cases to present commonalities, challenges, and benefits of the processes, policies, and procedures used to acquire AM technology and manage IP in the private and public sector.

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V. ANALYSIS

A. INTRODUCTION

This chapter will use the cases presented in Chapter IV to identify the means of procurement, benefits, challenges, and concerns of IP management associated with AM implementation. It will compare Maersk and NASA's 3D procurement strategies and assess IP rights entitlements based on those strategies. Next, it will address the impacts of patent infringement case law and the ability of DON to modify commercially available 3D printers to meet its needs. The chapter will conclude with an assessment of file sharing agreements and methods, and the potential for DON to utilize these methods to acquire and manage 3D files in its supply chain.

B. HARDWARE PROCUREMENT CONSIDERATIONS

The following analysis presents IP considerations that must be factored into DON 3D printer acquisition. The procurement choices made by NASA and Maersk offer two distinct methods for managing IP rights associated with 3D printer procurement. The patent infringement lawsuits filed by Stratasys and 3D Systems illustrate additional concerns for DON procurement of AM assets for the Fleet.

1. Small Business Innovation Research

To support its unique requirements for 3D printing in zero gravity, NASA elected to conduct research and development into specialized 3D printers through multiple SBIR contracts.

The SBIR Program was enacted in 1982 to increase the involvement of small businesses in federally funded research (SBA, 2015). The program has several specific goals: to boost competition, productivity, and economic growth in the private sector through increased government partnerships with small businesses (SBA, 2015). The program seeks to accomplish these goal through the further development and eventual commercialization of small business concepts, ideas, and technology (SBA, 2015).

According to the SBIR Program Policy Directive, contracts awarded through the SBIR program progress through three phases (SBA, 2014). Phase I contracts support research to determine the viability of an innovation's commercial application. Phase II agreements provide for the further development of ideas vetted in Phase I. Phase III contracts support the acquisition of SBIR developed products and services through non-SBIR funding (SBA, 2014). Through each of these phases, IP rights are key in striking a balance between meeting future government requirements and needs through innovation, and ensuring small businesses are able to commercialize the new product, process, or service.

Data rights associated with SBIR are delineated by FAR 52.227-11 and FAR 52.227-20. FAR Part 52, Section 227–11 provides for government and contractor patent rights when a new invention is developed. Section 227–20 provides for government and contractor copyrights specifically associated with SBIR (FAR, 2015).

NASA has partnered with Made In Space and SMRC through SBIR contracts to support its zero-gravity requirements. It will gain assets able to meets its requirements as well as government purpose license rights to use the technology as it deems necessary. Made In Space and SMRC also benefit from these agreements because they retain intellectual property rights to the concepts and methods developed under the contract. This is especially important to small businesses such as Made In Space and SMRC as it provides a competitive advantage over larger companies. In particular, it allows these small businesses to require licensing and royalty fees from other businesses interested in using their technology.

2. Commercial Purchase: Private Sector

In its first attempt to implement AM into its container ship fleet, Maersk elected to purchase and install a 3D printer from Stratasys. This provided Maersk an opportunity to determine the viability of printing on-demand parts at sea; however, it also limited Maersk's ability to replicate Stratasys's product technology for its own use. Per Stratasys's purchase and sales license agreement, Maersk is now only permitted to use the printer software internally and in association with Stratasys equipment (Stratasys

Ltd., 2015). Additionally, Maersk cannot directly or indirectly alter, reverse engineer, or create a derivative product based on the Stratasys printer (Stratasys Ltd, 2015). Lastly, per Stratasys's customer agreement, Maersk must grant Stratasys "a fully paid-up, royalty free, worldwide, non-exclusive, irrevocable, transferable right and license in, under, or to any patents or copyrights associated with the use or functionality of the printer or compositions created by the operation of Stratasys equipment" (Stratasys, 2015, *Customer Agreement*).

3. DON Procurement of 3D Printers

Per FAR Part 12, Section 101, government agencies are required to prioritize the use of commercial items to meet agency requirements over the research and development of new processes and products (FAR, 2015). To maximize the use of commercial products in government acquisition, this policy also applies to contractors and subcontractors at all levels (FAR 12.101(c)). In the case of DON 3D printer procurement, this could be especially problematic due to intellectual property infringement concerns.

IP infringement concerns become an issue for installing commercial 3D printers on Navy ships for two reasons. The first is related to commercial user terms and agreements. The second is associated with design and methodology patent rights.

In accordance with FAR Part 12, one option the Navy has to procure 3D printers is to purchase the products from a current 3D manufacturer. Similar to the Navy's current onboard use of Dell computers, 3D printers would be installed onboard ships and utilized by the crew. Sailors onboard would be trained to use, repair, and maintain the equipment. The difference between Dell computers and commercial 3D printers is the software permitted to be uploaded and used with each. Even though the Navy purchases computers from Dell, it is not restricted to only using Dell software on the systems. Navy leadership determines what software programs will be uploaded to the systems for shipboard use. By contrast, 3D printer manufacturers may restrict the software used on the machine to the software developed by the manufacturer. As seen in Stratasys's user terms and agreements, only Stratasys software is permitted to be used on its printers (Stratasys, 2015). This can create a potential constraint on Navy implementation of AM into the

Fleet as special software developed and authorized by the DON may be required with 3D printers to assure information security. If the Navy is unable to install and use encrypted software with commercially sourced 3D printers, this could limit the type of parts printed onboard and on-demand.

The second option for procuring 3D printers for the Fleet is to contract with a company to develop a 3D printer tailored to function under constantly changing sea conditions. In this case, IP infringement issues arise if a contractor attempts to modify or reverse engineer an already existing 3D printer to fit the needs of the Navy. This case also illustrated in the Maersk case where Maersk utilized a Stratasys printer to test the viability of printing at sea, but was unable to modify the printer to function in a maritime environment due to Stratasys's user agreements. In especially stringent circumstances, restrictions on modifications could also apply to altering the external parts of the printer to secure it for rolling seas.

In addition to restricting modifications of already existing printers, patent infringement issues become a concern in the development of a new system to meet Navy requirements. As seen with both Stratasys and 3D Systems, a contractor attempting to incorporate existing AM processes into a new printer designed for the Navy could encounter patent infringement issues. A solution to this constraint is for the contractor to pay a license fee to the IP owner for use of the equipment, process, or technology; however, this often results in a higher cost to the Navy.

C. CAD AND STL FILE RIGHTS

Copyright and patent infringement related to equipment procurement is not the only challenge DON must overcome with respect to IP in order to implement AM in the Fleet. The ability to acquire and use CAD and STL files for parts presents an additional challenge.

Traditionally, when the Navy acquires a new weapons system, it negotiates with contractors for data rights in order to compete the manufacture of additional replacement parts. This is to ensure the Navy receives the best value for its dollar. It also ensures that the Navy does not become dependent on a specific contractor for parts, which eliminates

monopolies. The potential implementation of AM in the Fleet will likely change this traditional process. Instead of contracting for the data rights associated with physical parts, DON will require rights to use CAD and STL files to print the parts itself. This could result in a major cost difference as manufacturers and suppliers may increase data right costs to compensate for lost revenue from physical part supply. Academia and current Internet based file sharing websites are modeling this new brand of agreement between DON and its suppliers.

1. Electronic Database Agreements

In order to utilize AM onboard ships for on-demand printing, DON end-users will require access to CAD and STL files from defense manufacturers and suppliers. One way to provide access to CAD and STL files is to create a DON authorized electronic database. The creation of an electronic database to manage CAD and STL files would provide DON end users a means to print parts as needed.

The National Information Standards Organization's SERU and LMLA provide possible formats for DON agreements with its defense partners for access to manufacturer developed CAD and STL files. Similar to a library agreement with owners of scholarly works, DON could utilize the LMLA or SERU as a template to negotiate a subscription for access to defense partner websites tailored to DON user needs. The agreement terms could be negotiated based on expected failure and replacement rates for various parts. This structure provides a way for DON to compensate defense partners for access to files needed for on-demand printing while allowing these partners to retain the same level of IP rights assigned in traditional contracting. This could also prevent the cost of data rights from rising.

Another option for an electronic database would be an electronic mall (e-mall) of authorized Navy CAD and STL file providers similar to Traceparts's electronic database. The e-mall would provide DON users a resource of authorized CAD and STL file providers that meet DON specifications. This format would allow for DON to negotiate reasonable prices per each item or part on the database. End users would pay per file download, which eliminates DON's requirement to monitor the amount of use under a

subscription. Additionally, this allows DON to negotiate directly with suppliers for license agreements and owners of proprietary information retain IP rights. One potential drawback to this format is that DON would have a harder time tracking levels of use per part or supplier unless the database was administered by DON.

2. Print and Ship Services

Another way for DON to indirectly utilize AM technology to support the Fleet is to create depots capable of printing and shipping parts to end users or partnering with private companies able to print and ship.

Both of these formats require an online database that is connected to a supplier able to print and ship parts. The Navy depot model would require a database similar to that described in the above section; the end-user would utilize a database or website to select the part required and material to support the end-user needs. Reimbursement for the cost of the part would be provided from the end-user directly to the DON depot printing the part. Next, the depot would print and ship the part to the end-user. This model allows the Navy to negotiate at a programmatic or DON wide level for use of defense partner developed CAD and STL files limiting the level of data rights the government would require to reproduce required parts. It also provides a vehicle for the Navy to negotiate compensation for use of defense partner data while keeping proprietary IP rights with the manufacturer or supplier.

A second model for print and ship services to support the Fleet would be similar to Shapeways's printing services. The Navy would provide its end users a database of companies authorized to 3D print parts; the end user would select a part and material and await arrival of the part via delivery service. This model increases the level of data rights required from defense partners in order to support third party printing of the parts. The increased level of data rights required by DON to support this format could increase the cost of compensation demanded by the contractor depending on the level of trade secrets included in the CAD or STL files. The cost to acquire data rights could also increase due to the risk of a third party obtaining the files and utilizing them to adopt the information as its own.

D. CONCLUSIONS

The success of AM implementation into the Navy is dependent on DON's ability to acquire both the hardware and data rights to support 3D printing. Key factors to be considered in the procurement of hardware include whether a commercial or developmental product will be procured, the extent manufacturer developed software, material, and spare parts must be used, and the level of modification required for the equipment to be effective in a maritime environment. Commercial procurement and SBIR programs offer two different options for acquiring systems. Commercial procurement allows a faster and less complex procurement; however, an as-is product may not meet Navy requirements. The SBIR program provides a method for the Navy to develop a system that specifically meets its needs, but may take longer to develop and procure. Both methods require negotiation of user agreements; however, the SBIR program would likely permit the Navy more freedom to utilize the product as needed.

The procurement of data rights to support 3D printing will require careful negotiation by DON acquisition professionals. Industry already has concerns related to government misuse of technical data, and CAD and STL files will likely add more concerns due to the ease of copying, modifying and reproducing digital files without permission from owners. This is especially worrisome in the defense industry as defense partners will want to ensure their patents, copyrights, and trade secrets do not fall into competitors' hands. DON will have to be especially vigilant to ensure both external counterfeiting and internal misuse does not occur.

DON will also have to negotiate with each manufacturer to include the terms of use for both equipment and CAD/STL files. The number of authorized printings or applications for CAD and STL files would also have to be negotiated early in the acquisition process. The examples in this chapter illustrate several formats for industry and DON file sharing, which protect industry IP rights while providing DON access to use the files to print parts.

In both cases, acquisition of hardware and data rights to support 3D printing may increase the cost of procurement as defense industry partners seek compensation to

license their products, processes, and designs. The cost of data rights may also rise due to a loss of business in producing parts for the DON that can now print itself.

VI. CONCLUSION AND RECOMMENDATIONS

A. OVERVIEW

The primary goal of this research was to determine how AM is impacting the laws governing copyrights, patents, trademarks, and trade secrets. It also aimed to identify the methods and procedures used in both the private and public sector to acquire and implement AM. A secondary goal of this project was to identify ways the DON must adapt current policy and procedures to support the broader implementation of AM across the Navy enterprise.

This research began with an introduction to IP and government data rights and reviewed the laws and regulations guiding the use and protection of those rights. An introduction to AM was also provided as well as a discussion on the way that IP governs AM processes.

Next, federal, DOD, and DON policies and procedures were reviewed to illustrate the parameters acquisition professionals must work within when acquiring data rights for defense weapon systems. Industry concerns with the application of these data rights and the ease of digital file sharing were also explored. The Napster lawsuit provided an example of how quickly digital file sharing can infringe on IP ownership.

A multi-case analysis followed to illustrate specific concerns associated with AM implementation in both the private and public sector. Various means to legally share digital files were also assessed with a specific focus on CAD and STL files required in 3D printing. The lessons learned from these cases were then applied to potential Navy AM implementation scenarios to illustrate the challenges DON may face when acquiring hardware and data rights to support this initiative.

B. LIMITATIONS

Research into the application of AM within the DON has become more prevalent in recent years; however, IP infringement concerns are a new area of study. Due to limited research on IP impacts to government policy, private sector concerns and impacts

of AM on industry were utilized to determine potential government data rights concerns. Access to AM contract agreements was not made available so research was conducted by accumulating data from articles, scholarly journals, DOD and DON regulations and instructions, and government reports of past AM and IP research. Access to different AM contract procurement vehicles could have allowed for more detailed analysis of intellectual property concerns and data right clauses.

C. RESEARCH FINDINGS

This research found that AM is creating challenges to the administration of current IP laws and regulations in the private sector. In particular, design and patent infringement are growing issues as new companies attempt to join the AM industry. IP infringement concerns revolve around whether improved or new AM technologies are unique enough to warrant new patents.

Another concern of AM industry leaders is the illegal and unauthorized sharing of CAD and STL files. Similar to the issues Napster created within the music industry, consumers are able to copy, modify, and use CAD and STL files without receiving permission from the IP owner. Enforcing IP infringement is especially hard in this case as tracking each wrongful use of these files is nearly impossible.

Methods and procedures used by both the private and public sectors in the procurement of 3D printers provided insight into how IP can constrain the use of AM hardware. Specifically, commercially procured products may not allow for modification to meet unique user requirements, such as operations in a maritime or zero-gravity environment. Commercial procurement may also preclude the use of DON specific software, which presents an additional security problem for its end users.

A review of industry concerns associated with government data right policy provided insight into the willingness of industry to provide its IP to DOD. Primary concerns associated with government data rights included a mistrust of the government to appropriately use and manage data, contractor rights to retain trade secrets and commercialize technology brought to maturity under government contracts, and the potential to lose all rights to the data due to government interpretation.

Lastly, the lessons learned from industry were applied to DON implementation of AM. This research found that DON will need to exercise care when procuring AM assets and negotiating government data rights. The Navy should also be prepared to pay more for these data rights as 3D printing changes the nature of long-term business with defense contractors.

D. RECOMMENDATIONS

In order for the Navy to manage the challenges associated with IP and data rights of AM, planning for its use in weapon system procurement and life-cycle support should be incorporated into the first stages of acquisition planning. Specifically, the level of 3D data rights needed to support a weapons system should be assessed and included in the IP strategy. The IP strategy provides program managers a vehicle to manage the data rights deliverables, patent technologies, and license rights associated with 3D printing for the entire life cycle of the system. Early identification of 3D printing requirements also provides contracting officers guidance on tailoring contract clauses to specifically meet government needs while protecting industry IP rights.

As AM processes become more prevalent across the DOD and DON, both entities should develop instructions and guidance specific to the incorporation and procurement of AM assets and digital data rights. The development of an AM specific instruction or guidebook would provide a standardized means to implementing the technology across the DOD and at a minimum the DON. It would also help manage contractor expectations when AM processes are included in contracts.

E. FURTHER RESEARCH

Additional research related to the implementation of AM in the DON could focus on a variety of IP specific factors including patent rights, management formats for digital files and the cost to acquire license rights to 3D print parts as-needed. In particular, further research could explore the Navy's opportunity to leverage expiring AM process and technology patents to tailor 3D printers to meet DON specific requirements. The potential to develop maritime specific AM equipment could lead to future cost savings as the DON will own a greater portion of the data rights without having to pay license fees.

DON developed equipment could also mitigate software security concerns as DON could install its own encrypted software into these systems.

An analysis of the various formats for digital file sharing could also lead to future costs savings or additional expenses. Specifically, a DON managed database would provide end users a single resource for authorized CAD and STL files that meet military specs; however, it could also result in increased costs to develop the database and provide personnel to maintain it. Comparatively, an externally managed database may be less costly.

The cost to acquire data rights to 3D print on-demand parts is another area for further research. Industry already exercises caution when contracting with the DOD, especially when negotiating data rights; the digital format of CAD and STL files used in 3D printing could raise the cost of data rights as the risk to contractors increases. Research into the cost of acquiring data rights to 3D print within the Fleet compared to requesting 3D printed replacement parts from defense industry partners could also contribute to DON's decision to implement AM across the Navy enterprise.

APPENDIX A. FAR CLAUSE MATRIX

FAR Part 27 sets forth guidance for the use of contract clauses associated with IP in government contracts. Additional guidance for the use of these clauses is found in Far Part 52. Clauses specific to IP are provided in Section 227. The following matrix, published by USD (AT&L) in its 2001 report on IP in commercial contracts, provides a summary of the clause as well as legal references (USD [AT&L], 2001).

FAR 52.227-1: Authorization and Consent

Statutory Reference	None
Regulatory Reference	FAR 27.202-2
Principal Objective	To notify the government of a patent infringement lawsuit that the government must defend
Applicability	Supply, service, or research and development contracts above the simplified acquisition procedures threshold except when performance and delivery will be made outside the United States
Requirements	The contractor promptly notifies the contracting officer upon notice or claim of patent or copyright infringement based on the performance of the contract.

FAR 52.227-2: Notice and Assistance Regarding Patent and Copyright Infringement

Statutory Reference	None
Regulatory Reference	FAR 27.202-2
Principal Objective	To notify the government of a patent infringement lawsuit that the government must defend
Applicability	Supply, service, or research and development contracts above the simplified acquisition threshold except when performance and delivery will be made outside the United States
Requirements	The contractor promptly notifies the contracting officer upon notice or claim of patent or copyright infringement based on the performance of the contract

FAR 52.227-3: Patent Indemnity

Statutory Reference	None
Regulatory Reference	FAR 27.203-1(b), 27.203(a), or 27.203-4(a)(2) as applicable
Principal Objective	Ensures that the government purchases items that otherwise incorporate commercially available components, free and clear of any patent claims or liability.
Applicability	All contract except those for research and development (using Alternate I of FAR 52.227-1), supplies or services not previously sold in the commercial marketplace, work to be performed outside the United States, contracts using simplified acquisition procedures, or architect-engineer work
Requirements	The contractor must indemnify the government against liability, including costs, for infringement of nay U.S. patent arising out of the manufacture or delivery of supplies or performance of services under a contract

FAR 52.227-4: Patent Indemnity—Construction Contracts

Statutory Reference	None
Regulatory Reference	FAR 27.203-5
Principal Objective	Ensures that the government is not exposed to any patent infringement claims or liability under construction contracts (consistent language with 52.227-3).
Applicability	Fixed-price contacts for construction, dismantling, demolition, or removal of improvements.
Requirements	The contractor agrees to indemnify the government against liability, including costs and expenses, for infringement of any U.S. patent.

FAR 52.227-5: Waiver of Indemnity

Statutory Reference	28 U.S.C. 1498(a)
Regulatory Reference	FAR 27.203-6
Principal Objective	To waive indemnification by the contractor and authorize the use and manufacture, solely in performing a contract, of any invention covered by a U.S. patent identified in the contract.
Applicability	Contracts for which a written approval from the agency head or designee is obtained. Must be in the government's interest and must be solely for performance of the contact.
Requirements	The government authorizes the contractor to use and manufacture, solely in performing the contract, any invention covered by the U.S. patens identified herein; and waives indemnification by the contractor with respect to such patents.

FAR 52.227-6: Royalty Information

Statutory Reference	None
Regulatory Reference	FAR 27.204-2
Principal Objective	To obtain royalty payment information in proposals in order to conduct cost/price analysis, ensure the royalty is proper, and ensure the government is not paying a royalty to which it otherwise has a license.
Applicability	Negotiated contracts.
Requirements	Requires the offeror to disclose, as part of its proposal, the amount of royalty paid, patent numbers, and a brief description of the component on which a royalty is paid. Also, if requested by the contracting officer before the execution of the contract, the offeror shall furnish a copy of the current license agreement and an identification of applicable claims of specific patents.

FAR 52.227-7: Patent—Notice of Government Licensee

Statutory Reference	None
Regulatory Reference	FAR 27.204-3(c)
Principal Objective	To advise offerors, through the solicitation, when the government intends to pay a patent royalty for items to be procured under the contract.
Applicability	Contracts for which the government has agreed to pay a patent royalty.
Requirements	Sets forth the patent information, royalty rate, and owner and licensee information.

FAR 52.227-9: Refund of Royalties

Statutory Reference	None
Regulatory Reference	FAR 27.206-2
Principal Objective	To ensure that the government does not overpay royalties.
Applicability	Negotiated fixed-price contracts for which the contracting officer believes it is questionable whether substantial amounts of royalties will have to be paid.
Requirements	Establishes requirements for royalty payments to ensure they are properly chargeable.

FAR 52.227-10: Filing of Patent Applications—Classified Subject Matter

Statutory Reference	None
Regulatory Reference	FAR 27.207-2
Principal Objective	To prevent classified information from entering the public domain.
Applicability	Contracts that may result in a patent application containing classified subject matter.
Requirements	The contracting officer must approve the filing of a U.S. patent application that includes disclosure of any contract subject matter classified as "confidential" or higher.

FAR 52.227-11: Patent Rights—Retention by the Contractor (Short Form)

Statutory Reference	35 U.S.C. 202–204 and 37 C.F.R. 401
Regulatory Reference	FAR 27.303 (a)
Principal Objective	To ensure that inventions developed by small business firms and domestic nonprofit organizations, with federal funding, are utilized for the public benefit.
Applicability	Contracts for experimental, developmental, or research work with small businesses and nonprofit organizations.
Requirements	The contactor must disclose an invention within two months after the inventor identifies it in writing to contractor personnel responsible for patent matters. Where the government obtains the title and the contractor has a nonexclusive domestic licenses, the license may be revoked or modified by the government to the extent necessary to achieve expeditious practical application. For inventions where the contractor acquires title, the government has the right to require the contractor to grant a nonexclusive, partially exclusive, or exclusive license to a responsible applicant. The contractor flows down the same frights to the subcontractor and will not, as part of the consideration for awarding the subcontract, obtain rights in the subcontractor's subject inventions.

FAR 52.227-12: Patent Rights—Retention by the Contractor (Long Form)

Statutory Reference	35 U.S.C. Sec. 202, 204, and 210 (c), Presidential Memorandum 2/18/83 and Executive Order 12591
Regulatory Reference	FAR 27.302(f), 27.302(g), 27.303(b), 27.303(d)(1)(ii), and FAR 27.304-1 (g)
Principal Objective	To ensure that inventions developed with funding from DOD the Department of Energy, and the National Aeronautics and Space Administration by large, for-profit businesses are utilized for the public benefit.
Applicability	The contractor is other than small business firm or nonprofit organization and the effort if for experimental, research, or development work.
Requirements	The contractor must disclose inventions within two months after the inventor discloses in writing to contractor personnel, or within six months after the contractor become aware that an invention has been made, whichever is earlier; where the government obtains the title and the contract has a nonexclusive domestic license, the license may be revoked of modified by the government to the extent necessary to achieve an expeditious practical application.

FAR 52.227-12: Patent Rights—Retention by the Contractor (Alternate I)

Statutory Reference	35 U.S.C. 202(c)(4)
Regulatory Reference	FAR 27.303(b)(2)
Principal Objective	To honor U.S. treaties and agreements with foreign governments and international organizations.
Applicability	The contractor is other than a small business firm or nonprofit organization and the effort is for experimental, research, or developmental work.
Requirements	The government has the right to sublicense foreign governments, their nationals, and international organizations pursuant to specifically identified treaties or international agreements.

FAR 52.227-12: Patent Rights—Retention by the Contractor (Alternate II)

Statutory Reference	35 U.S.C. 202(c)(4)
Regulatory Reference	FAR 27.303(b)(2)
Principal Objective	To honor U.S. treaties and agreements with foreign government and international.
Applicability	Long-term contract where the contractor is other than a small business firm or nonprofit organization and the effort is for experimental, research, or developmental work.
Requirements	The government has the right to unilaterally amend the contract to identify specific treaties and international agreements entered into after the effective date to effectuate the granting of licenses and other rights to relevant organizations. The contracting officer has the discretion to modify the clauses in FAR 52.227-11; 52.227-12, and 52.227-13 to make it clear that the rights granted to the foreign government or international organization may be additional rights beyond a license or sublicense if so required by the applicable treaty or international agreement.

FAR 52.227-13: Patent Rights—Acquisition by the Government

Statutory Reference	41 U.S.C. 418a (d) and 35 U.S.C. 202(a)(i)
Regulatory Reference	FAR 27.303(c), FAR 27.302(i)2
Principal Objective	To provide for contract to be performed outside the United States by large, for-profit companies.
Applicability	The contractor is foreign and the effort is for experimental research, or developmental work.
Requirements	The contractor agrees to assign to the government the entire right, title, and interest to each subject invention. The contractor's domestic licenses may be revoked or modified to the extent necessary to achieve an expeditious practical application of the subject invention.

FAR 52.227-14: Rights in Data

Statutory Reference	41 U.S.C. 418 (a)
Regulatory Reference	FAR 27.409(a), 27.302(i)1, 27.303(c), 52.227-13
Principal Objective	For the government to have unlimited data rights to data first produced under a contact.
Applicability	Not applicable to DOD (See Far 27.400)
Requirements	Sets forth rights in data for contract where data will be produced, furnished, or acquired (with some notable exceptions). For data other than software, the contractor grants to the government, and others acting on its behalf, a paid-up, nonexclusive, irrevocable worldwide license in the copy-righted data to reproduce, prepare derivative works, distribute copies to the public, and perform and display publicly.

FAR 52.227-15: Representation of Limited Rights Data and Restricted Computer Software

Statutory Reference	41 U.S.C. 418a (d)(5)
Regulatory Reference	FAR 27.409(g)
Principal Objective	When limited-rights data or restricted computer software are likely to be used, the insertion of this clause into the solicitation will generate a response from the contractor that will help the contracting officer use an appropriate data rights clause in the award.
Applicability	Applies to civilian agency solicitations that include the clause FAR 52.337-14, Rights in Data. Not applicable to DOD.
Requirements	Establishes the requirement for contractors to assert limited-or restricted-rights data that may be included in the contract data to be delivered.

FAR 52.227-16: Additional Data Requirements

Statutory Reference	None
Regulatory Reference	FAR 27.409(h)
Principal Objective	Enables the government access to data generated under the contract by not established at the outset of the contract.
Applicability	Applies to civilian agency contract involving experimental, developmental, research, or demonstration work. Not applicable to DOD. (See FAR 27.400)
Requirements	The contracting officer may, at any time during contract performance or within a period of three years after acceptance of all items to be delivered under the contract, order any data first produced or specifically used in the performance of the contract.

FAR 52.227-17: Rights in Data—Special Works

Statutory Reference	None
Regulatory Reference	FAR 27.409(i)
Principal Objective	Establish unlimited government rights to copyrighted material and indemnification under the contract.
Applicability	Applies to civilian agency contracts and solicitations primarily for the production or compilation of data for the government's internal use. Not applicable to DOD. (See FAR 27.400).
Requirements	The government shall have unlimited rights in the data delivered under the contract and in all data first produced in the performance of the contract, and the contractor will indemnify the government against liabilities for infringement of trade secrets and copyrights.

FAR 52.227-18: Rights in Data—Existing Works

Statutory Reference	None
Regulatory Reference	FAR 27.409(j)
Principal Objective	Acquire worldwide nonexclusive license to reproduce subject matter being acquired.
Applicability	Applies to civilian agency solicitations and contracts exclusively for the acquisition of existing audiovisual and similar works. Not applicable to DOD. (See FAR 27.400).
Requirements	The contractor grants to the government a paid-up, nonexclusive, irrevocable, worldwide license to reproduce the works, prepare derivative works, and perform and display them publicly.

FAR 52.227-19: Commercial Computer Software—Restricted Rights

Statutory Reference	None
Regulatory Reference	FAR 27.409(k)
Principal Objective	To ensure that the contract contains terms to obtain sufficient rights for the government to fulfill the need for which the software is being acquired.
Applicability	Applies to civilian agency acquisitions of existing computer software. Not applicable to DOD. (See FAR 27.400).
Requirements	The government shall have the right to use, duplicate, or disclose any restricted computer software delivered under the contract.

FAR 52.227- 20: Rights in Data—SBIR Program

Statutory Reference	15 U.S.C. 638, SBIR Reg. at 37 C.F.R. 401
Regulatory Reference	FAR 27.409(l)
Principal Objective	Establishes government and contractor rights under Small Business Innovative Research (SBIR) program contracts.
Applicability	Applies to civilian agency contracts awarded under the SBIR program. Not applicable to DOD. (See FAR 27.400).
Requirements	The government shall have unlimited rights in the data except where the small business has retained the rights and given a notice accordingly. The contractor shall have the right to protect data delivered and establish claims to copyrighted material in accordance with the clause procedures.

FAR 52.227-21: Technical Data Declaration, Revision, and Withholding of Payment—Major Systems

Statutory Reference	41 U.S.C. 418 (a) (d) 7, 8, 9 and 41. U.S.C. 403 (a)(9)(10)
Regulatory Reference	FAR 27.409(q)
Principal Objective	To ensure quality of delivered technical data under contract.
Applicability	Applies to civilian agency contracts for major system acquisitions. The technical data to which the clause applies must be specified in the contract. Not applicable to DOD. (See FAR 27.400).
Requirements	The contractor must make a declaration that the technical data delivered under the contract is complete and accurate and complies with the requirements of the contract. The government has the right to withhold payment until data requirements are properly satisfied.

FAR 52.227-22: Major System—Minimum Rights

Statutory Reference	None
Regulatory Reference	FAR 27.409(r)
Principal Objective	Establishes unlimited rights to all data under the contract.
Applicability	Applies to civilian agency contracts for major systems for civilian agencies except NASA and U.S. Coast Guard. Not applicable to DOD. (See FAR 27.400).
Requirements	The government shall have unlimited rights in any technical data, other than computer software, developed in the performance of this contract.

FAR 52.227-23: Rights to Proposal Data (Technical)

Statutory Reference	None
Regulatory Reference	FAR 27.409(s)
Principal Objective	Establishes unlimited rights to proposal data.
Applicability	Applies to civilian agency acquisitions in which the contracting officer desires to acquire unlimited rights in technical data contained in a successful proposal upon which a contract award is based. Not applicable to DOD. (See FAR 27.400).
Requirements	As a condition to the award of the contract, the government shall have unlimited rights in and to the technical data contained in the proposal upon which the contract is based, except for those pages marked by the offeror as proprietary.

APPENDIX B. DFARS CLAUSE MATRIX

DFARS Part 252.227 provides additional IP clauses specifically related to the DOD. The following matrix is provided from the USD (AT&L)'s 2001 report on IP to simplify and synopsize the statutory and regulatory references associated with these clauses.

DFARS 252.227-7000: Non-Estoppel

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-1
Principal Objective	Provides the right to challenge the validity of patents and patent applications licensed under a contract.
Applicability	Patent release and settlement agreements, license agreements, and assignments executed by the government, when it acquires rights.
Requirements	The government reserves the right to contest, at any time, the enforceability, validity, scope of, or title to any patent or patent application without waiving or forfeiting any rights under the contract.

DFARS 252.227-7001: Release of Past Infringement

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-2(a)
Principal Objective	Releases the government from any patent infringement liability of inventions identified in a contract.
Applicability	Patent release and settlement agreements, license agreements, and assignments, executed by the government, under which the government acquires rights.
Requirements	The contractor releases the government from any claims for the manufacture of use by the government, prior to the contract's effective date, of any inventions covered by a patent and identified in a contract.

DFARS 252.227-7002: Readjustment of Payments

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-2(b)
Principal Objective	To ensure that the government does to overpay royalties.
Applicability	Contracts providing for a payment of running royalty.
Requirements	The contractor will give the government the same royalty rates given to other licensees of the patent.

DFARS 252.227-7003: Termination

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-2©
Principal Objective	To preserve the government's right to terminate a license agreement.
Applicability	Contracts providing for a payment of running royalty.
Requirements	The government reserves the right to terminate a license by giving the contractor 30 days' notice in writing.

DFARS 252.227-7004: License Grant

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-3(a)
Principal Objective	To ensure the acquisition of a patent license agreement.
Applicability	Patent release and settlement agreements, as well as license agreements that do not provide for royalty payment.
Requirements	The contractor grants the government an irrevocable, nonexclusive, nontransferable, paid-up, government-purpose license under the designated patents.

DFARS 252.227-7005: License Term

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-3(b)
Principal Objective	To ensure the government's right to terminate a license agreement.
Applicability	Patent release and settlement agreements, and license agreements not providing for royalty payment by the government.
Requirements	Depending on which Alternate is used (I or II), the government defines the term of the license.

DFARS 252.227-7006: License Grant Running Royalty

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-4(a)
Principal Objective	To define the patent license grant.
Applicability	Patent release and settlement agreements, and license agreements, when the clause is desired to cover the subject matter thereof and the contract provides for royalty payment.
Requirements	The contractor grants the government an irrevocable, nonexclusive, nontransferable license under the designated patents.

DFARS 252.227-7007: License Term—Running Royalty

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-4(b)
Principal Objective	To define the term of the patent license.
Applicability	Patent release and settlement agreements, and license agreements, when the clause is desired to cover the subject matter thereof and the contract provides for royalty payment.
Requirements	The license granted shall remain in full force and effect for the term of the patent unless terminated sooner.

DFARS 252.227-7008: Computation of Royalties

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-4(c)
Principal Objective	To specify the royalty rate of a license.
Applicability	Patent release and settlement agreements, and license agreements, when the clause is desired to cover the subject matter thereof and the contract provides for royalty payment.
Requirements	Establishes the royalty rate.

DFARS 252.227-7009: Reporting and Payment of Royalties

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-4(d)
Principal Objective	To report the royalty amount owed by the government.
Applicability	Patent release and settlement agreements, and license agreements when the clause is desired to cover the subject matter and the contract provides for royalty payment.
Requirements	The procuring office shall report to the contractor the amount of royalties accrued and arrange for payment to the contractor.

DFARS 252.227-7010: License to Other Government Agencies

Statutory Reference	None
Regulatory Reference	DFARS 227.7009-4(e)
Principal Objective	To provide similar license terms to other government agencies.
Applicability	When it is intended that a license be made available to other government agencies on the same terms and conditions that appear in the contract license agreement.
Requirements	The contractor agrees to grant, to other government agencies, license under the same terms and conditions that appear in the contract license agreement.

DFARS 252.227-7011: Assignments

Statutory Reference	None
Regulatory Reference	DFARS 227.7010
Principal Objective	To provide for patent assignments.
Applicability	Contracts assigning patent rights to the government.
Requirements	The government identifies the detailed information of the patent to be conveyed

DFARS 252.227-7012: Patent License and Release Contract

Statutory Reference	None
Regulatory Reference	DFARS 227.7012
Principal Objective	To provide a format for inserting various patent license and release clauses as prescribed in the FAR and DFARS.
Applicability	For contracts of release, license, or assignment.
Requirements	The clause details the language to be used in a contract.

DFARS 252.227-7013: Rights in Technical Data—Noncommercial Items

Statutory Reference	10 U.S.C. 2320, EO 12591, 15 U.S.C. 638 for Alt II
Regulatory Reference	DFARS 227.7013-6(a)
Principal Objective	To set forth respective rights to technical data delivered under a contract.
Applicability	All contracts for noncommercial items under which technical data are to be delivered, except when the only deliverable items are computer software or computer software documentation.
Requirements	Defines unlimited rights, limited rights, government-purpose rights, specifically negotiated license rights, and prior government rights. The contractor is required to provide a certified list of all asserted rights and restrictions in the furnished technical data. The contractor agrees to release the government from liability for release or disclosure of technical data. The contractor and higher-tier subcontractors or suppliers shall not use their power to award subcontracts as economic leverage to obtain rights in technical data from their subcontractors or suppliers.

DFARS 252.227-7014: Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation

Statutory Reference	None
Regulatory Reference	DFARS 227.7203-6(a)(1)
Principal Objective	To set forth respective rights to computer software and computer software documentation delivered under the contract.
Applicability	Contracts for noncommercial computer software or computer software documentation, except for technical data.
Requirements	Defines unlimited rights, restricted rights, government-purpose rights, specifically negotiated license rights, and prior government rights. Contractor is required to provide a certified list of all asserted rights and restrictions in the furnished software.

DFARS 252.227-7015: Technical Data—Commercial Items

Statutory Reference	10 U.S.C. 2320, EO 12591
Regulatory Reference	DFARS 227.7102-3 Contract Clause
Principal Objective	To define the government's rights in technical data related to commercial items.
Applicability	All solicitations and contracts involving commercial items where technical data is being acquired and for prime contracts where the subcontracts may require this clause in lieu of DFARS 252.227-7013.
Requirements	Defines the terms of the license for technical data, as well as restrictions placed on the government.

DFARS 252.227-7016: Rights in Bid or Proposal Information

Statutory Reference	None
Regulatory Reference	DFARS 227.7013-6(e)(1), 227,7014(e)(1), or 227.7203-6(b)
Principal Objective	To allow the government to use the information submitted in bids or proposals.
Applicability	Solicitations and contracts under which the successful offeror will be required to deliver technical data to the government.
Requirements	Defines the government's rights prior to, and subsequent to, contract award.

DFARS 252.227-7017: Identification and Assertion of Use, Release, or Disclosure Restriction

Statutory Reference	10 U.S.C. 2320
Regulatory Reference	DFARS 227.7103-3(b), 227.7014€(2), or 227.7203-3(a)
Principal Objective	To identify the nature of data to be delivered with other than "unlimited rights."
Applicability	All solicitations that include the clause DFARS 252.227-7013 or 7014.
Requirements	The contractor must identify all data (technical and computer software) that will be delivered with less than unlimited rights.

DFARS 252.227-7018: Rights in Noncommercial Technical Data and Computer Software—SBIR Program

Statutory Reference	15 U.S.C. 638
Regulatory Reference	DFARS 227.227.7104(a) License Rights
Principal Objective	To identify the scope of data rights to be delivered under the Small Business Innovative Research (SBIR) program.
Applicability	Research contracts under the SBIR program.
Requirements	Identifies the government's rights in the data developed under all phases of SBIR programs.

DFARS 227.7019: Validation of Asserted Restrictions—Computer Software

Statutory Reference	None
Regulatory Reference	DFARS 227.227.7104€(3) or 227.7203-6©
Principal Objective	To evaluate the contractor's asserted restrictions.
Applicability	Small Business Innovative Research solicitations and contracts.
Requirements	The clause identifies requirements for the government's need to have information and the government's right to challenge asserted restrictions.

DFARS 252.227-7020: Rights in Special Works

Statutory Reference	None
Regulatory Reference	DFARS 227.7105-3, 227.7016(a), or 227.7205(a)
Principal Objective	To ensure that the government has an assignment or at least license rights to copyrighted works commissioned by the government.
Applicability	Solicitations and contracts under which the government has specific need to control the distribution of works first produced, created, or generated during contract performance.
Requirements	The clause spells out the government's rights.

DFARS 252.227-7021: Rights in Data—Existing Works

Statutory Reference	None
Regulatory Reference	DFARS 227.7105-2(a). Acquisition of existing works without modification.
Principal Objective	To provide necessary license rights to the government for existing copyrighted works.
Applicability	Existing works.
Requirements	The clause defines “works” and the government’s rights to a nonexclusive license.

DFARS 252.227-7022: Government Rights (Unlimited)

Statutory Reference	None
Regulatory Reference	DFARS 227.7107-1(a)
Principal Objective	To define the scope of the government’s unlimited rights.
Applicability	Architectural designs and construction contracts.
Requirements	The government shall have unlimited rights in all drawings, designs, and specifications, and retains a paid-up license.

DFARS 252.227-7023: Drawings and Other Data to Become Property of the Government

Statutory Reference	None
Regulatory Reference	DFARS 227.7107(b)
Principal Objective	To define the government’s rights in drawings and other data.
Applicability	Contracts involving architect-engineer services.
Requirements	All designs, drawings, and specifications developed under the contract become the sole property of the government.

DFARS 252.227-7024: Notice and Approval of Restricted Design

Statutory Reference	None
Regulatory Reference	DFARS 227.7107-3
Principal Objective	To preserve the government’s rights in restricted designs.
Applicability	Architectural and construction contracts.
Requirements	Where the contractor’s designs require products and material that can be obtained only from a sole course, the contracting officer’s approval is required.

DFARS 252.227-7025: Limitation on the Use or Disclosure of Government-Furnished Information Marked with Restrictive Legends

Statutory Reference	None
Regulatory Reference	DFARS 227.7103-(c), 227.714(f)(1), or 227.7203-6(d)
Principal Objective	To limit the contractor’s use of government-furnished information.
Applicability	Solicitations where the government furnishes information to the contractor.
Requirements	Where government-furnished information marked with legends is misused or misappropriated, the contractor will indemnify the government, as the information may be proprietary to another contractor.

DFARS 252.227-7026: Deferred Delivery of Technical Data or Computer Software

Statutory Reference	10 U.S.C. 2320 (b) (2)
Regulatory Reference	DFARS 227.7103-8(a)
Principal Objective	To protect the government’s interest in deferring the delivery of technical data or computer software.
Applicability	Contacts where necessary or applicable.
Requirements	The government has the right to defer the delivery of technical data or computer software for up to two years after the acceptance of all other items.

DFARS 252.227-7027: Deferred Ordering of Technical Data or Computer Software

Statutory Reference	10 U.S.C. 2320 (b) (2)
Regulatory Reference	DFARS 227.7103-8(b)
Principal Objective	To give the government time to determine whether it needs technical data or computer software under a contract.
Applicability	Solicitations when carious technical data and computer software requirements cannot be specifically identified, but there is a potential need for technical data and computer software generated under the contract.
Requirements	The government may order any technical data or computer software generated under the performance of a contract. Such order may be made within three years after the acceptance of all items.

DFARS 252.227-7028: Technical Data or Computer Software Previously Delivered to the Government

Statutory Reference	10 U.S.C. 2320(b)(1)
Regulatory Reference	DFARS 227.7103-6(d), 227.7104(f)(2) or 227.7203-6(e)
Principal Objective	To identify all technical data and computer software that previously have been delivered to the government, but that the contractor intends to deliver with less than unlimited rights.
Applicability	Solicitations for which the resulting contract will require the contractor to deliver technical data and computer software that were or are deliverable under another government contract.
Requirements	Offerors must identify any technical data and computer software specific in the solicitations deliverable technical data and computer software items that are the same or substantially the same as technical data and computer software items the offeror has delivered or is obligated to deliver, either as a contractor or subcontractor, under any other Federal agency contract.

DFARS 252.227-7030: Technical Data—Withholding of Payment

Statutory Reference	10 U.S.C. 2320(b)(9), 41 U.S.C. 418a(d)(9)
Regulatory Reference	DFARS 227.7103-6€(2), or 227.7104€(4)
Principal Objective	To have leverage in enforcing the contract.
Applicability	Solicitations and contracts that include the clause DFARS 252.227-7013, Right in Technical Data--Noncommercial Items.
Requirements	If technical data delivered under the contract is not delivered on time or is deficient, the contracting officer may withhold 10 percent of the contract price until government accepts such data.

DFARS 252.227-7032: Rights in Technical Data and Computer Software (Foreign)

Statutory Reference	10 U.S.C. 2320 (b) (1)
Regulatory Reference	DFARS 227.7103-17
Principal Objective	For the furtherance of mutual defense of the U.S. Government and the other governments.
Applicability	Contracts with foreign contractors to be performed overseas (except Canadian purchases)
Requirements	The U.S. Government may duplicate, use, or disclose all technical data and computer software, under the contract, to other governments.

DFARS 252.227-7033: Rights in Shop Drawings

Statutory Reference	None
Regulatory Reference	DFARS 227.7107-1(c)
Principal Objective	The government may acquire exclusive control of the data pertaining to the design if the government does not want the construction to be duplicated for any special reason.
Applicability	Solicitations and contracts calling for the delivery of shop drawings. The clause is to be included in all subcontracts at any tier.
Requirements	The government shall obtain unlimited rights in shop drawing for construction.

DFARS 252.227-7034: Patents—Subcontracts

Statutory Reference	None
Regulatory Reference	DFARS 227.304-4
Principal Objective	To have all parties involved in developing research, comply with the requirements of FAR 52.227-12.
Applicability	Solicitations and contracts pertaining to experimental, developmental, or research work by small business or domestic nonprofit organizations whose contract contains FAR 52.227.11.
Requirements	The contractor shall include FAR 52.227-12 in subcontracts to be performed by other than small business or nonprofit organization.

DFARS 252.227-7036: Declaration of Technical Data Conformity

Statutory Reference	10 U.S.C. 2321 (b) (7)
Regulatory Reference	DFARS 227.7103-6€(3) or 227.7104€(5)
Principal Objective	Ensure the contractor's accountability for data delivered.
Applicability	All solicitations and contract (for noncommercial items), and when the successful offeror will be required to deliver technical data.
Requirements	The contractor provides a declaration that the technical data delivered is accurate and complies with the requirements of the contract.

DFARS 2252.227-7037: Validation of Restrictive Markings on Technical Data

Statutory Reference	10 U.S.C. 2321, 10 U.S.C. 2320 (b) (1)
Regulatory Reference	DFARS 227.7102-3(c), 227.7103-6(e)(4), or 227.7203-6(f)
Principal Objective	To protect the government's right to challenge the validity of restrictions marked on technical data packages.
Applicability	All solicitation and contracts.
Requirements	The contractor and subcontractor are responsible for maintaining records to justify the validity of markings that impose restrictions on the government and other to use, duplicate, or disclose delivered technical data.

DFARS 252.227-7039: Patents—Reporting of Subject Inventions

Statutory Reference	None
Regulatory Reference	FAR 27.304-1(e), DFARS 227.303(a)
Principal Objective	To keep track of, and preserve the government's rights in, inventions developed under the contract.
Applicability	Solicitations and contracts containing the clause FAR 52.227-11.
Requirements	The contractor shall furnish interim reports every 12 months, as well as a final report within 3 months after completion of the contract, as to whether any inventions were developed under the contract. The reports must provide all information regarding the contractor's patent application.

DFARS 252.204-7000: Disclosure of Information

Statutory Reference	None
Regulatory Reference	DFARS 204.404-70 (a)
Principal Objective	To prevent the release of unclassified, but sensitive, information to the public.
Applicability	Solicitations and contracts when the contractor will have access to or generate unclassified information that may be sensitive and inappropriate for release to the public.
Requirements	The contractor and subcontractor shall not release, to anyone outside their organization, any unclassified information pertaining to any part of the contract, unless the contracting officer has given prior approval.

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